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PHILOLOGICAL STUDIES IN ANCIENT GLASS

By
MARY LUELLA TROWBRIDGE

A. B. University of Illinois, 1915

A. M. University of Illinois, 1916

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
DEGREE OF DOCTOR OF PHILOSOPHY IN CLASSICS IN THE
GRADUATE SCHOOL OF THE UNIVERSITY OF
ILLINOIS, 1922

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1930

PREFACE

In this study only Greek and Latin literature is considered; no attention is paid to the literature of other nations, Egyptian, Babylonian and the like, unless it exists in an ancient Greek or Latin version. In excerpting the written records of all kinds a great deal of time was necessarily consumed because many of the works, as for example the Greek medical writers, do not contain satisfactory indices. For the Greek side the collections are not quite so exhaustive as for the Latin. Here the author enjoyed the invaluable services of so competent a scholar as Dr. J. B. Hofmann of Munich, who generously furnished, from the material of the *Thesaurus Linguae Latinae*, a complete list of the passages in which any word for glass was to be found. In general it is to be hoped that little of importance has been passed over in either field down to the fourth century after Christ. From that period onwards the collections are no longer so extensive, particularly in patristic literature.

Two sections of this study, written under the direction of Dr. W. A. Oldfather, were submitted in partial fulfillment of the requirements for the doctor's degree in 1922. The completion of the other sections was made possible by the subsequent use of the libraries of the Universities of Illinois, Wisconsin, Utah, Columbia, Cornell, and Washington State College.

The writer is glad to have this opportunity of expressing her thanks to Dr. W. A. Oldfather in particular, not only for suggesting the subject, but also for help in collecting material, for advice and criticism, and for assistance with the proof; to President A. S. Pease for many helpful suggestions and criticisms on the sections used as her thesis, and for material from his reading; to Drs. Rachel Sargent, J. C. Austin, A. F. Pauli, and Eunice Couch for valuable aid in reading the proof, and much helpful advice; to all the professors, librarians, and graduate students in the institutions in which the writer has worked, for assistance in many ways, or for making the facilities of the institutions available to her; and to the University of Illinois for publishing this study.

Originally it had been the intention to publish the Latin text and the English translation of Heraclius and Theophilus upon the

manufacture and coloring of glass, treatises which date from the early Middle Ages and undoubtedly contain much of the technical knowledge of late classical antiquity. However, since an entirely new text of these is in process of preparation, it has seemed best to omit that part of the study in the present publication.

MARY TROWBRIDGE HONEY

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I. THE PURPOSE OF THIS STUDY

Since almost every important excavation adds something to the treasures of glass, it is not strange that archaeologists should find in the study of the objects themselves an unending source of interest. Consequently the history of glass has been admirably treated from an archaeological standpoint, most recently, for example, in the exhaustive work, *Das Glas im Altertume*, by Anton Kisa. In the present study, therefore, there will be no use of the actual objects found, except incidentally; literary evidence alone will be considered, and that of all kinds. This, then, is a linguistic and historical study solely, intended to supplement from the side of written or inscriptional records the works on archaeology.

From the linguistic point of view the Greek and Latin words for glass will be treated; from the historical, both the manufacture of glass and its uses. In the first place, the purpose of this study is to take up chronologically the different Greek words by which glass was designated, such as *kyanos*, *lithos chytê*, *hyalos*, and *krystallos*, as well as the Latin *vitrum*, and discuss their etymology, orthography, derivatives and compounds, and meaning.

On the historical side the archaeologist can go back much farther than any one who is simply searching through written records. By chemical analysis he can find out what materials were used; by an examination of actual objects he can tell how they were made; by the discovery of the glass ovens he can locate some of the chief manufacturing centers; from the amount of glass discovered, its particular variety, and the place of discovery, he can draw conclusions as to the importance of the trade. The present study aims to supplement all this with what the Greeks and Romans themselves record of the manufacture of glass, of the story they tell of its origin, of the materials, where to obtain them and what proportions to use, of how to build the furnace, and color and handle the molten glass, of the different kinds of glass, and where they were made. And, furthermore, if it were not for literary evidence, especially the Roman law, there would not be even a glimpse of the social standing of the workmen who made these beautiful objects. From the classification of glass with precious metals, from the incidents recorded in history, and from the laws, comes otherwise unobtainable

evidence for the importance of the trade. Although the museums contain many glass objects not mentioned in literature, there are a few things recorded in literature which are known only from that source, as, for instance, the use of glass compounded with other substances as a medicine. The different objects will be treated chronologically in the order in which they are first mentioned in literature.¹ Even if there are few new uses to be recorded, the incidents told about the objects may be of interest, and the date² of the first recorded instance of employment for one purpose or another will have a certain degree of importance as a modest contribution to the history of material civilization. Throughout, then, in the historical part as well as in the philological, my aim is solely to supplement the study of actual monuments with literary evidence.

¹ Of course this method of listing the uses of glass is without prejudice to the question of the relative date at which glass was actually employed for different purposes. Archaeological evidence is of prime importance for that aspect of the general problem, and literary evidence must in this respect be used with circumspection, since, strictly speaking, it affords usually only the *terminus post quem*.

² In listing dates Roman numerals stand for the centuries before Christ and Arabic numerals for those after Christ.

II. THE GREEK WORDS FOR GLASS

A. *Kyanos*

In Homer there is no instance of *hyalos*, the word by which glass was designated in later times; nevertheless glass in the form of paste or enamel was known and referred to by the term *kyanos*. It is mentioned in the description of the palace of Alcinous, about the bronze walls of which there ran a frieze of *kyanos*.¹ In the hut of Nestor there was a table with feet of *kyanos*.² Its use in the decoration of armor, however, seems to have been especially widespread. The breastplate of Agamemnon was inlaid with *kyanos*, gold, and tin; the central boss of his shield was of the same material, as well as the snakes on his breastplate and baldric.³ On the shield of Achilles a ditch of *kyanos* ran about the vineyard.⁴ Somewhat later the author of the *Shield of Herakles*, a work of the Hesiodic school, speaks, probably in imitation of Homer, of 'zones' or 'concentric bands' of *kyanos* upon the shield of that hero.⁵

From the early poets no idea of the nature of this substance can be obtained, but something can be learned concerning its color and appearance. Homer calls the *kyanos* on the armor *melas*, 'black,' which probably means no more than 'dark.' As an adjective

¹ *Od.* 7, 87(86): χάλκεοι μὲν γὰρ τοῖχοι ἐληλέδατ' ἔνθα καὶ ἔνθα, | ἐς μυχὸν ἐξ οὐδοῦ, περὶ δὲ θριγκὸς κῡάνοιο. Schol. E on *Od.* 7, 87: κῡάνοιο δὲ ὁ ἔχων τὴν βαθὴν ἀπὸ τοῦ κῡάνου εἶδος βάμματος ὄντος· κῡάνος, κῡάνεος, κυανοῦν, ὡς χρύσεος, χρύσειος, χρυσοῦν· ὅστις κῡάνος ἐστὶ μέλας. Eust. 1570, 28: ὁ δὲ κῡάνος, χρῶμά τι μέλαν ἐξ οὗ τὸ κῡάνειον μετουσιαστικῶς, ἀφ' οὗ κῡάνεον καὶ κυανοῦν. κῡάνεος δὲ νῦν ὁ θριγκὸς τῷ τείχει, ὡς ἂν οὕτως ἀεροειδὲς τὸ μετέωρον φαίνοιτο.

² *Il.* 11, 629 (628): ἦ σφωιν πρῶτον μὲν ἐπιπροΐηλε τράπεζαν | καλὴν κυανόπεζαν εὐξοον. Cf. Schol. A. Eust. 867, 27: τὸ δὲ κυανόπεζαν μετὰ τοῦ τράπεζαν ἔχει μὲν τι κάλλους διὰ τὸ ὁμοίῳ κατὰληκτον· δηλοῖ δὲ οὐ μόνον τὴν ἀπὸ κῡάνου ἔχουσαν τοὺς πόδας, καθὰ καὶ ἀργυρόπεζα λέγεται ἢ ἐξ ἀργύρου, ἀλλὰ καὶ τὴν ἔχουσαν κυανέαν τὴν πέζαν, ὅ ἐστι τὸν ἔξω κύκλον, καθὰ φασιν οἱ παλαιοί.

³ *Il.* 11, 24ff.: τοῦ δ' ἦ τοι δέκα οἴμοι ἔσαν μέλανος κῡάνοιο, | δώδεκα δὲ χρυσοῖο καὶ εἴκοσι κασσιτέριοι· | κῡάνεοι δὲ δράκοντες ὀρωρέχατο προτὶ δειρὴν | τρεῖς ἐκάτερθ' . . . ἐν δὲ οἱ ὀμφαλοὶ ἦσαν εἴκοσι κασσιτέριοι | λευκοί, ἐν δὲ μέσοισιν ἦν μέλανος κῡάνοιο . . . τῆς δ' ἐξ ἀργύρεος τελαμῶν ἦν· αὐτὰρ ἐπ' αὐτοῦ | κῡάνεος ἐλέλικοτο δράκων. Interlin. gl. in A (*Il.* 11, 24): κῡάνοιο: μέλανος, καταπληκτικού. Eust. 828, 20: κῡάνος δὲ εἶδος τι χρώματος μέλανος, ἐξ οὗ τὸ κῡάνειον, καὶ ὑφαιρέσει τοῦ διχρόνου κῡάνεον, καὶ ἐν συναιρέσει κυανοῦν. Cf. Schol. BL on 11, 24.

⁴ *Il.* 18, 564: ἀμφὶ δὲ κυανὴν κάπετον.

⁵ Hes. *Sc.* 143: κῡάνου δὲ διὰ πτύχες ἠλέλαντο.

or in compounds he uses it to refer to the hair,⁶ the beard,⁷ the brow,⁸ the eyes,⁹ the clouds,¹⁰ the phalanx,¹¹ the prows of ships,¹² the sands of Charybdis,¹³ and the robe of Thetis.¹⁴ When the hair of Poseidon is mentioned, it would not seem altogether inappropriate to consider it as resembling the dark blue of the sea.¹⁵ The eyes of Amphitrite also would doubtless be blue; but in none of the other instances is there any suggestion of blueness. Some of them could be black, but all of the references convey at least the idea of darkness.¹⁶ What then was this dark material used upon walls, shields, and tables?

Theophrastus (*S.IV/III*) is the first to say anything about the nature of the substance. "*Kyanos*, too," he writes, "is both natural and artificial, as in Egypt. There are three kinds of *kyanos*: the Egyptian, the Scythian, and third, the Cyprian. The Egyptian is best for the darker colors; the Scythian for the lighter."¹⁷ The Egyptian is artificial. And those who write about the kings also record which

⁶ Usually as an epithet of Poseidon, *Il.* 13, 563 (562): ἀμενήκωσεν δὲ οἱ αἰχμήν | κυανοχαῖτα Ποσειδάων, βιότοιο μεγέρας. *Il.* 14, 390; 15, 174, 201; 20, 144. *Od.* 3, 6; 9, 528; 9, 536: ὡς ἔφατ' εὐχόμενος, τοῦ δ' ἔκλυε κυανοχαίτης. Of a horse, *Il.* 20, 224. Of Hector, *Il.* 22, 402 (401): ἀμφὶ δὲ χαῖται | κνάνει πίτναντο. Cf. Eust. 1276, 26.

⁷ *Od.* 16, 176: κνάνει δ' ἐγένοντο γενεαῖδες ἀμφὶ γένειον. Cf. Eust. 1798, 63; 1799, 19, 25.

⁸ *Il.* 1, 528, of Zeus: ἧ καὶ κυανεῖσιν ἐπ' ὀφρύσι νένσε Κρονίων. Schol. BLV: κνάνει δὲ αἱ μέλαινα καὶ αἱ καταπληκτικά. Cf. *Il.* 17, 209. Of Hera, *Il.* 15, 102. Cf. Eust. 1008, 2ff.

⁹ *Od.* 12, 60 (59), of Amphitrite: προτὶ δ' αὐτὰς | κῆμα μέγα ῥοχθεῖ κυανώπιδος Ἀμφιτρίτης.

¹⁰ *Il.* 5, 345 (344): καὶ τὸν μὲν μετὰ χερσὶν ἐρύσατο Φοῖβος Ἀπόλλων κυανέη νεφέλῃ. *Il.* 16, 66. Cf. Eust. 1046, 9. *Il.* 20, 418; 23, 188. Cf. Eust. 1295, 34. *Od.* 12, 75. Cf. Eust. 1714, 5. *Od.* 12, 405; 14, 303.

¹¹ *Il.* 4, 282 (280): τοῖαι ἄμ' Αἰάντεσσι διοτρεφέων αἰζήων | δῆμον ἐς πόλεμον πυκινὰ κίνυντο φάλαγγες | κνάνει.

¹² *Il.* 15, 693ff.: ὡς ἔκτωρ ἴθυσε νεὸς κυανοπρώροιο | ἀντίος αἰζας. *Il.* 15, 693; 23, 852, 878. *Od.* 3, 299; 9, 482, 539; 11, 6; 12, 100, 148, 354; 14, 311; 22, 465.

¹³ *Od.* 12, 243 (242): ὑπένερθε δὲ γαῖα φάνεσκε | ψάμμῳ κυανέῃ.

¹⁴ *Il.* 24, 94 (93): ὡς ἄρα φωνήσασα κάλυμ' ἔλε δὲα θεῶν | κνάνειον, τοῦ δ' οὐ τι μελάντερον ἔπλετο ἔσθος.

¹⁵ Of course, sea-green is also possible, but hair is seldom, if ever, greenish in appearance, and the southern seas, unlike those of the north, are predominantly blue, not green, in color.

¹⁶ The scholiasts on Homer, and Eustathius, had the feeling that *kyanos* was *melas*. In Greek literature *kyanos* and *melas* are applied to the same things, as the aegis, horses, hair, eyes, water, ships, and the like. See Ebeling, *Lex. Homer.* 1, 920ff.

¹⁷ Literally, "The Egyptian is best for the pure pigments; the Scythian for the weaker."

king first melted *kyanos* so as to imitate the natural, and that when gifts are being sent by some, from Phoenicia there is sent a tribute of *kyanos*, both unfired and burnt. And those who grind the pigments say that *kyanos* of itself makes four colors, the first lighter from the thinner parts, and the other darker from the thicker."¹⁸ As for the natural *kyanos* he speaks of two kinds, a lighter and a darker,¹⁹ from the color of which the sapphire is not far removed.²⁰ It is found with metals²¹ and contains a trace of a golden color,²² which would give it a glistening appearance. Dioscorides (*S.I*) mentions only the *kyanos* of Cyprus.²³ Theophrastus is followed more or less accurately by Pliny (*S.I*) in his *Natural History*, where in one place he uses *caeruleum*²⁴ for *kyanos*, and in another the transliterated form, *cyanos*.²⁵ He adds little except that in his own day there was a preference for the *caeruleum* of Cyprus.²⁶

Theophrastus had to be interpreted before his description could throw any light on the *kyanos* of the early poets. It was not until

¹⁸ *De Lap.* 55: ἔστι δέ, ὥσπερ καὶ μίλτος ἡ μὲν αὐτόματος ἡ δὲ τεχνική, καὶ κύανος ὁ μὲν αὐτοφυῆς ὁ δὲ σκευαστὸς ὥσπερ ἐν Αἰγύπτῳ. γένη δὲ κύανου τρία, ὁ αἰγύπτιος, καὶ σκύθης, καὶ τρίτος ὁ κύριος. βέλτιστος δ' ὁ αἰγύπτιος εἰς τὰ ἄκρατα λειώματα, ὁ δὲ σκύθης εἰς τὰ ὑδαρέστερα. σκευαστὸς δ' ὁ αἰγύπτιος. καὶ οἱ γράφοντες τὰ περὶ τοὺς βασιλεῖς καὶ τοῦτο γράφουσι, τίς πρῶτος βασιλεὺς ἐποίησε χυτὸν κύανον μιμησάμενος τὸν αὐτοφυῆ, δῶρά τε πέμπεσθαι παρ' ἄλλων τε καὶ ἐκ Φοινίκης φόρον κύανου, τοῦ μὲν ἀπύρου τοῦ δὲ πεπυρωμένου, φασὶ δὲ οἱ τὰ φάρμακα τρίβοντες τὸν μὲν κύανον ἐξ ἑαυτοῦ ποιεῖν χρώματα τέτταρα, τὸ μὲν πρῶτον ἐκ τῶν λεπτοτάτων λεπτότατον, τὸ δὲ δεύτερον ἐκ παχυτάτων μελάντατον.

¹⁹ *Ibid.* 31: καλεῖται δὲ καὶ κύανος ὁ μὲν ἄρρην ὁ δὲ θήλυν· μελάντερος δὲ ὁ ἄρρην.

²⁰ *Ibid.* 37: καὶ ἦν καλοῦσι σάπφειρον· αὕτη γὰρ μέλαινα οὐκ ἄγαν πόρρω τοῦ κύανου τοῦ ἄρρενος καὶ πρασίτις.

²¹ *Ibid.* 51: εὐρίσκεται δὴ πάντα ἐν τοῖς μετάλλοις τοῖς ἀργυρεῖς τε καὶ χρυσεῖς, ἔνια δὲ καὶ ἐν τοῖς χαλκορυχείς, οἷον ἄρρενικόν, σανδαράκη, χρυσοκόλλα, μίλτος, ὦχρα, κύανος· ἐλάχιστος δὲ οὗτος καὶ κατ' ἐλάχιστα.

²² *Ibid.* 39: καὶ κύανος αὐτοφυῆς ἔχων ἐν ἑαυτῷ χρυσοκόλλαν.

²³ 5, 106: κύανος δὲ γεννᾶται μὲν ἐν Κύπρῳ ἐκ τῶν χαλκορυγῶν μετάλλων· ὁ δὲ πλείων ἐκ τῆς αἰγιαλίδος ἄμμου, εὐρισκόμενος κατὰ τινας σπηλαιώδεις ὑποσκαφὰς τῆς θαλάσσης, ἥτις καὶ διαφέρει.

²⁴ 33, 161: caeruleum harena est. huius genera tria fuere antiquitus: Aegyptium maxime probatur; Scythicum mox diluitur facile et cum teritur, in quattuor colores mutatur, candidiorem nigrioremve et crassiorem tenuioremve; praefertur huic etiamnum Cyprium.

²⁵ 37, 119: redditur et per se cyanos, accomodato paulo ante et iaspidi nomine a colore caeruleo. optima Scythica, dein Cypria, postremo Aegyptia adulteratur maxime tinctura, idque in gloria est regum Aegypti; adscribitur et qui primus tinxit. dividitur autem et haec in mares feminasque. inest ei aliquando et aureus pulvis, non qualis sappiris; in his enim aurum punctis conlucet. See Blümner, *P.-W.* 11, 2239.

²⁶ By *caeruleum* the Romans understood a kind of pigment. See Blümner, *Tech. u. Term.* 4, 499ff.; *Thes. Ling. Lat.* 3, 107.

Lepsius,²⁷ by an interpretation of the Egyptian inscriptions and by chemical analysis, identified the three kinds, that its nature was understood. The view of Lepsius was accepted and further developed by Helbig.²⁸ They identified the natural *kyanos* of Scythia with lapis lazuli and the color obtained from it; the *caeruleum Cyprium* of Pliny, the *kyanos* of Cyprus, with the blue pigment found in crystals or in the earth near copper-beds, that is azurite, a form of copper ore; the artificial *kyanos* of Egypt with glass paste resembling the others in color. Since Cyprus, which was noted for its copper, was under Phoenician control for a long time, the unfired *kyanos* taken by the Phoenicians to the Egyptian king was identified with the azurite from the copper-beds. The next step was to conjecture that the *kyanos* of Homer's palace was an artificial blue glass-paste,²⁹ and this view was confirmed by the discovery of just such a frieze at Tiryns.³⁰ The decoration on the shields would naturally be of the same material. Since Cyprus was noted for its *kyanos*, it may be of some significance that the breastplate of Agamemnon was a gift from Cinyras, king of that island.³¹ Although this is not the only interpretation,³² it seems the most logical;^{32a}

²⁷ *Die Metalle in den ägypt. Inschriften* (Abhandl. d. Berl. Akad. (1871), 69-79, 130ff.).

²⁸ *Das homer. Epos*, ed. 2 (1887), 100ff.

²⁹ *Ibid.* 106. An alchemical writer speaks of *hyalos* called *kyanos*, however, probably referring to the color of the glass. Berthelot, *Collection*, 349, 4: ὁμοῦ εὐρήσεις ὕδρον βένετον, τὸν λεγόμενον κύανον.

³⁰ Schlieman, *Tiryns* (1885), 284ff.; Müller, *Die Gr. Staats-, Kriegs-u. Privat-antiquitäten* (1887), 348; Baumeister, *Denkmäler*, 3(1888), Taf. 77; Van Leeuwen et Mendes da Costa, *Homeri Od. Carm.* (1890), on 7, 87; Schuchhardt, *Schliemann's Excavations*, 141 (Trans. by Sellers (1891), 116); Kavvadias, *Προϊστορική Ἀρχαιολογία* (1909), 199; Finsler, *Homer* (1913), 296; Drerup, *Homer*, ed. 2 (1915), 51; Hall, *Aeg. Arch.* (1915), 198.

³¹ *Il.* 11, 21ff.: πείθετο γὰρ Κύπρονδε μέγα κλέος, οὐνεκ' Ἀχαιοὶ | ἐς Τροίην νήεσσιν ἀναπλέεσθαι ἐμελλον | τοῦνεκά οἱ τὸν δῶκε χαρίζομενος βασιλῆϊ.

³² *Kyanos* was long rendered by "blue steel." See Blummer, *P.-W.* 11, 2242. Sir Arthur Evans in *The Palace of Minos* (1921), identifies *kyanos* with cobalt blue 534: "In the earlier part of the Middle Minoan Age a deep natural blue was in use. Somewhat later, however, a blue of brilliant cobalt hue, a crystalline silicate of copper, begins to take its place, and by the beginning of the Late Minoan Age the predominance of this splendid pigment was fully established. It is clear that this is identical with the blue pigment early in use in Egypt and may be regarded as an Egyptian product. Its frequent use in Crete from the closing phase of the Middle Minoan Period onwards is one of the many indications of close commercial relations with the Nile Valley. This material is the classical 'kyanos' and mediaeval 'smalt.'" 374: "... Late Minoan frescoes in which the bright 'kyanos' or cobalt blue was so much employed." *Id.* 472: "Cobalt paste formed of pounded *kyanos*."

however, the identification of the *kyanos* of the frieze with glass does not go unquestioned, for there is also the possibility that the author had in mind a natural *kyanos*.³³

As a substantive *kyanos* does not occur frequently in later literature, and when it does, it is often clearly a reminiscence of Homer. Plato (*S. V* / IV)³⁴ describes the Styx as having a color like that of *kyanos*. Eratosthenes' (*S. III*)^{34a} mention of "zones darker than shining *kyanos*" brings to mind at once the inlaid work on the Homeric shields. When *kyanos* was used for the adornment of surfaces, at first glass-paste was meant, and later a kind of paint. The latter would present a shining appearance, and when applied to a quill,³⁵ it is spoken of as *porphyryion*, 'dark.' It was also used for painting walls³⁶ and little toy figures or idols.³⁷ In the field of natural history *kyanos* is the name of a bird³⁸ and of plants,³⁹ applied no doubt because of their color.

In describing the same inlaid gaming board, 473: "plaster coated with blue paste of *kyanos*."

^{32a} Hall, *op. cit.* 204, on the gaming board mentioned above: "Blue paste formed of pounded lapis-lazuli-like glass, the Homeric *kyanos*." Cunliffe, *A Lex. of the Hom. Dial.* (1924), *s. v.* κύανος: "glass paste or enamel coloured with a pigment doubtless to be identified with the pigment of brilliant cobalt hue largely used in the palace at Cnossus." Knapp (*The Class. Weekly*, 18 (1924), 57-58).

³³ Blümner, *P.-W.* 11, 2242.

³⁴ *Phaedo*, 113Bf.: τούτου δὲ αὐ καταντικρὺν ὁ τέταρτος ἐκπίπτει εἰς τόπον πρῶτον δεινόν τε καὶ ἄγριον ὡς λέγεται, χρώμα δ' ἔχοντα ὄλον οἶον ὁ κύανος, ὃν δὴ ἐπονομάζουσι Στύγιον.

^{34a} Achill. Tat. *Isag.* (*Patr. Gr.* 19, 980C): 'Ερατοσθένης ἐν τῷ 'Ερμῇ λέγων· πέντε δὲ αἱ ζῶναι περιειλάδες ἐσπεύρηνται· αἱ δύο μὲν γλαυκοῖο κελαϊνότεραι κύανοιο.

³⁵ Crinagoras (*Anth. Pal.* 6, 229): Διευτοῦ ἀγκυλοχείλου ἀκρόπτερον ὀξὺ σιδήρῳ | γλυφθέν, καὶ βαπτῇ πορφύρεον κύανῳ.

³⁶ Paus. 5, 11, 5: τούτων τῶν ἐρυμάτων ὅσον μὲν ἀπαντικρὺ τῶν θυρῶν ἐστίν, ἀλήλιπται κυανῷ μόνον.

³⁷ *Lex. Lexiph.* 22: ὡς νῦν γε ἐλελήθεις σπαντὸν τοῖς ὑπὸ τῶν κοροπλάθων ἐς τὴν ἀγορὰν πλαττομένοις οἰκῶς, κεχρωσμένοι μὲν τῇ μίλτῳ καὶ τῷ κύανῳ, τὸ δ' ἐνδοθεν πήλινος τε καὶ εὐθρυπτος ὢν.

³⁸ Arist. *H. A.* 9, 18, 21: ἔστι δὲ τις πετραῖος ᾧ ὄνομα κύανος· οὗτος ὁ ὄρνις ἐν Νισύρῳ μάλιστα ἐστίν, ποιεῖται δ' ἐπὶ τῶν πετρῶν τὰς διατριβάς. τὸ δὲ μέγεθος κοττύφου μὲν ἐλάττων, σπίζης δὲ μείζων μικρῷ. μελανόπους δέ, καὶ πρὸς τὰς πέτρας προσαναβαίνει. κυανοῦς ὄλος· τὸ δὲ ῥύγχος ἔχει λεπτὸν καὶ μακρὸν, σκέλη δὲ βραχέα τῇ πιποὶ παρόμοια. According to Thompson, *A Gloss. of Gr. Birds* (1895), 103ff, this was probably the wall-creeper, *Tichodroma muraria*, L.

³⁹ Meleager (*Anth. Pal.* 4, 1, 39ff.): τοῖς δ' ἄμ' Ἀλεξάνδροιο νέους ὄρηκας ἐλαίης, | ἥδὲ Πολυκλείτου πορφυρέην κύανον. Plin. *N. H.* 21, 68: in Italia violis succedit rosa, huic intervenit lilium, rosam cyanus excipit, cyanum amaranthus. The name is at present applied to *Centaurea Cyanus*, L., the bachelor's button.

If the glass-paste and azurite were called *kyanos* from their resemblance to lapis lazuli, the chief characteristic of *kyanos* would seem to be that of blueness. There is no reason to doubt that the *kyanos* of the poets was of that color. However, it is difficult to understand why the later use of the substantive and its derivatives and compounds does not convey solely that idea.⁴⁰ That these do not do so is clear from their use even in Homer, as well as in later writers. A few scattered references^{40a} will serve to show the divergence of feeling concerning its color.

Although the outstanding characteristic of *kyanos* and its derivatives in Homer is darkness, in nearly every instance they are applied to something that glistens. The snakes of *kyanos* are even compared with rainbows⁴¹ because of their bright, iridescent appearance. When Callimachus (*S.* IV)⁴² uses *kyaneos* to describe pitch, he certainly thinks of it as black, but black and shining. Aristotle (*S.* IV)⁴³ mentions *kyaneos* and *melas* side by side, as if they were a little different. *Kyaneos* probably means blue in Philostratus'⁴⁴ description (*S.* 2/3) of a peacock fish, which is so named from its color, for the striking characteristic of the peacock's feather is the remarkable eye-shaped patch of brilliant blue; but the

⁴⁰ In Latin compare the similar use of *caeruleus*, which is sometimes blue, sometimes dark, sometimes gleaming. See the articles on *caeruleus* and *cyaneus* in *Thes. Ling. Lat.*

^{40a} For a collection of references from Homer to Xenophon, see Platnauer (*Class. Quart.* 15 (1921), 160 f.).

⁴¹ *Il.* 11, 26f.: κύνεοι δὲ δράκοντες ὀρωρέχατο προτὶ δειρὴν | τρεῖς ἐκάτερθ', ἱρισσιν ἑοικότες. As a further development of this idea, the rainbow itself is called *kyanê*. Cf. Dio Chrysost. *Orat.* 12, 414 R: ἡ τανύοντα κυανῇν ἱρὴν.

⁴² *Hekale*, Col. 4, 49: κύνεον φῆ πῖσσαν.

⁴³ *Meteor.* 15, 342A, 34f.: τοῦ φωτὸς ἐκ κυανέου καὶ μέλανος. Cf. Paus. 10, 28, 7; Luc. *Quomodo Hist.* 19. Chalcid. in Plat. *Tim.* 321 (*F.P.G.* 2, 252): candido enim minimum distat quod dicitur pallidum aliquanto, plus quod appellatur rubrum, hoc amplius cyaneus color, plurimum vero nigredo. In drawing up a long list of the colors of painters Pollux also speaks of *kyanos* and black, but not of blue, so *kyanos* almost certainly stands for dark blue here. 7, 129: τὰ δὲ χρώματα, ἀνδρείκελον, δστρεον, πράσινον, κροκοειδές, κυανοῦν, κιννάβαρι, ξανθόν, φαιόν, φλογόλευκον, λευκόφαιον, λευκόν, μέλαν, μελαμβαφές. Apion, however, considers it the same as *melas*. *Etym. Gud.*: κύνεον τὸ χρῶμα· καὶ τὸ μέλαν. Cf. Ludwig in *Philologus*, n.s. 28, 245. Joh. Diakonos, *Scholia* on Hesiod's *Theogony* (Gaisford, 610, 10): κύνεον ἐνταῦθα τὸ μέλαν, ἀλλαχοῦ δὲ τὸ ἡέρανεον.

⁴⁴ *Vita Ap.* 1, 85: καὶ τοὺς ἰχθῦς τοὺς ταῶς, οὓς οὗτος μόνος ποταμῶν τρέφει, πεποιήνται δὲ αὐτοὺς ὁμωνύμους τοῦ ὀρνίθου, ἐπεὶ κύνεοι μὲν αὐτοῖς οἱ λόφοι, στικταὶ δὲ αἱ φολίδες, χρυσᾶ δὲ τὰ οὐράια καὶ, ὅποτε βούλονται, ἀνακλώμενα. On the color of the peacock cf. Dio Chrysost. *Orat.* 12, 11.

quality of iridescence might also have been in mind, for the peacock's feathers have that quality too, as does pitch, with which, as we have just seen, Callimachus compares *kyanos*. The same divergence is found also among the compounds of *kyanos*. Pallas is called "She of the *kyanos* aegis."⁴⁵ The son of Aegialeus, the Argive, is *Kyanippos*, 'Black-horse.'^{45a} When *kyanos* is used of water, the idea suggested is probably dark-blue-gleaming, when the reference is to the sea, but perhaps only dark, or dark-gleaming, when used of fresh water.⁴⁶ The vault of the heavens⁴⁷ is probably thought of as radiant blue.

In a study of glass it is impossible to consider in complete detail the later development of *kyanos*, its derivatives and compounds,⁴⁸ but a brief summary may be made from the lexicographers and etymologists of the fifth to the thirteenth centuries. In Hesychius (*S.* 5) the chief idea is that of darkness, if not of blackness, but he gives some instances where *kyanos* is used to indicate blueness, as the color of the heaven.⁴⁹ The same might be said of Photius (*S.* 9),⁵⁰ and the *Anecdota* edited by Bachmann (*S.* 9).⁵¹ In the latter, how-

⁴⁵ Pind. *Ol.* 13, 100ff.: κύναιγίς ἐν ὄρνει | κύνσσοντι οἱ παρθένος τόσα εἶπεν | ἔδοξεν. Since the aegis was originally a goatskin, and every Greek must have felt that as he used the word, *kyanos* here can hardly mean anything but black.

^{45a} For others of this name see *P.-W.* 11, 2236ff.

⁴⁶ Phryn. *Praep. Soph.* 78, 1f.: κυανανγῆς θάλαττα, καὶ κυανανγῆς ὕδωρ, καὶ κυανανγῆς ποταμός; and a diptych from Cairo (*Bull. Corresp. Hellén.* 28(1904), 208): κυανωπὸν ὕδωρ. Cf. Homer's 'dark water' (μέλαν ὕδωρ) used of the water of springs and rivers, on which see Ebeling, *Lex. Homer.* 1 (1885), 1038, col. 2, and for the rivers called Melas, no fewer than ten in number, see Pape-Benseler, *Wörterb. d. griech. Eigennamen* (1884) s. v. (in modern Greece also the Kephissos in Phokis is called *Mavropotamos*, 'Blackriver').

⁴⁷ Synes. *Hymn.* 9, 45: σὺ δὲ ταρσὸν ἐλάσσας, | κυανάντυγος οὐρανοῦ | ὑπερήλαο νώτων, | σφαίρησι δ' ἐπετάσθης | νοεραῖσιν ἀκράτοις | ἀγαθῶν ὅθι παγά, | σιγῶμενος οὐρανός.

⁴⁸ For further references see the articles on *kyanos*, its derivatives and compounds in Pape-Benseler, *op. cit.*; Roscher, *Ausführ. Lex. der gr. u. röm. Myth.*; *Thes. Gr. Ling.*; Pauly-Wissowa.

⁴⁹ *Lex.*: κυανέη· μελαίνη· φαιά. | κυανέησι· φαιαῖς. μελαναῖς. | κυάνεος· μέλας. σκοτεινός· ἐλέλικτο δράκων μέλας ἐν τῷ ἀναφορεῖ (*Hsd. op.* 528). | κυανέων· Μαύρων, Αἰθιόπων. | κυανόν· εἶδος χρώματος οὐρανοειδές. | κυανόπεζα· μελανόπους | κυανός· θαλάττιον ὕδωρ. καὶ ὄρνις. | κυανοχαίτης· μελανόθριξ. Ποσειδῶν. | ὑπερκυάνεον· λίαν κυάνεον.

⁵⁰ *Lex.* (ed. Porson (1822)): κυανέοι· μέλανες | κυανοχαίτης· μελάνθριξ· πορφυρόθριξ· Ποσειδῶν | Σαρδόنيος γέλως . . . ἐπ' ὄφρυσιν κυανέησιν.

⁵¹ 1, 284, 8: κυάνεοι· μέλανες. 284, 10: κυανοχαίτης· μελάνθριξ. πορφυρόθριξ· Ποσειδῶν.

ever, there is an exception: *glaukos* is defined as 'white, *kyaneos*.'⁵² This definition is repeated in Suidas (*S.* 10),⁵³ the *Etymologicum Gudianum* (*S.* 11),⁵⁴ and Zonaras (*S.* 12).⁵⁵ In none of the instances considered has there been any suggestion of literal whiteness, but the opposite, and Philoponus (*S.* 6) rightly lists *kyanos* among the colors more closely akin to black.⁵⁶ Reference has been made frequently, however, to the gleaming of *kyanos*, and it is very probable that at times it suggested simply something bright and shining. However, the *Anecdota* probably mean light-blue, or light-blue and glistening, for Plato says that a combination of *kyanos* and *leukos* produces *glaukos*.⁵⁷ It is to be observed that *kyanos* (or *kyaneos*) is used merely as a gloss for *glaukos*, not for *leukos*, *galakti eoikôs*, or the like, for in lexicographical definitions or synonyms, one cannot safely proceed upon the principle that things which are equal to the same thing are equal to each other, since it is not precisely 'the same thing' for which the several glosses are proposed. *Glaukos* clearly meant 'blue-bright,' 'gray-blue-bright,' and it is probable that the gloss *kyaneos* may have arisen from the application of *glaukos* in some poetical passage to an object that was commonly called *kyaneos*, or *vice versa*, from which the glossographer's deduction, that these words are used occasionally as roughly equivalent to one another, would be justified. Such objects would be the sea, water in general, eyes, hair, or mane (to all of which both *glaukos* and *kyaneos* are actually applied). Zonaras⁵⁸ also gives the ordinary meanings for *kyanos*, as well as the *Etymologicum Magnum*.⁵⁹ It may be because of the deep shade of *kyanos*,

⁵² 185, 12: γλαυκός: λευκός, κυάνεος. Cf. Hesych.

⁵³ *S.* v. γλαυκός: λευκός, κυάνεος.

⁵⁴ (Ed. Sturz), 126, 3: γλαυκός, λευκός, κυανός, γάλακτι ἐοικώς τὴν σάρκα καὶ τὰ ὅμματα.

⁵⁵ *Lex.* 438: γλαυκός. κυανός, ἢ λευκός, ἢ πυρῶδη τὰ ὅμματα ἔχων.

⁵⁶ On Aristotle's *de Anima*, 2, 406, 29: τὰ δὲ ἐγγυτέρω τοῦ μέλανος, ὡς τὸ κυαν-οῦν.

⁵⁷ *Tim.* 68C: λαμπρῷ δὲ λευκὸν συνελθὼν καὶ εἰς μέλαν κατακορὲς ἐμπεσὼν κυανοῦν χρῶμα ἀποτελεῖται, κυανοῦ δὲ λευκῷ κεραννυμένου γλαυκόν, πυρροῦ δὲ μέλανι πράσιον.

⁵⁸ *Lex.* 1262: κυανοχαίτης, μελανόθριξ. κυανὸν γὰρ τὸ μέλαν, καὶ χαιτή ἢ θρίξ. 1268: κυανόν. τὸ μέλαν.

⁵⁹ 542, 48: κυανός: ἐκ τοῦ κῦμα γίνεται κυμανός: καὶ ἀποβολῇ τοῦ Μ, κυανός, ὁ μέλας. κυάνειος, κυάνεος: καὶ ἡ κυανέα τῆς κυανέας. 641, 28: ψάμμω κυανέη, ἀντὶ τοῦ κυανίζουσα. 692, 32: κυανοπρώϊρους: καὶ παρὰ Σιμωνίδῃ, κυανοπρώϊραν. 718, 33: . . . ἕως τοῦ στομίου τοῦ Πόντου, ἔνθα εἰσὶν καὶ αἱ Κυάνεαι πέτραι.

which was called *melas* even in Homer and Theophrastus, that the idea of blueness gave way almost entirely to that of darkness. Or the original may have been simply the 'dark-gleaming,' which would be applicable to lapis lazuli because of its dark, glistening appearance (compare the passage quoted above in which Callimachus compares *kyanos* to pitch).

When there is such a divergence among ancient writers in their conception of the nature and color of *kyanos*, it is not strange that modern scholars should be puzzled by the word. The attempt to compare it with the Sanscrit *çjā-mā-s*, 'black,' has been abandoned,⁶⁰ and as yet the etymology is unknown.⁶¹

To summarize, then, it seems pretty certain that glass-paste was first called *kyanos* from its similarity to some natural stone or mineral. When actual glass, in the common meaning of the term, became better known, it was designated by a new term, because, no doubt, it was thought to be a different substance from *kyanos*. But the word by which glass-paste was originally known, went on developing new compounds and new derivatives which seldom, if ever, give any suggestion of material, but rather of color, sometimes blue, sometimes black, usually simply the idea dark, glistening, iridescent, or dark-gleaming. This last may have been the original idea from which the others developed in two directions, one emphasizing the idea of darkness, the other that of glistening or gleaming.

B. *Lithos Chytê*

For a long time the Greeks had no special word to designate glass in general. Although *kyanos* stood for a form of glass-paste, from the literary evidence there is no indication that it was applied except when the glass-paste was used in the adornment of surfaces. Very soon other uses for glass must have become familiar from imported wares and from the stories of travelers. A name was needed for new objects differing in form and color from the early *kyanos*. Herodotus (*S. V*) speaks of the material of which they were made as 'molten stone,' *lithos chytê*.¹ It is difficult to say whether this name was applied to glass because it was formed from melted silicates,

⁶⁰ Benfey in G. Curtius, *Gr. Etym.* ed. 5 (1879), 546; 612.

⁶¹ Boisacq, *Dict. Étym. de la Lang. Grec.* (1916), 527.

¹ Froehner, *La Verrerie Antique*, 4, thinks that Herodotus probably translated an Egyptian expression.

or because after a process of melting, a product resembling precious stones or crystals resulted, but more probably the latter, since the silicates used were generally in the form of sand, which the Greeks would scarcely have called stone.

Since *kyanos* was first imitated in Egypt, it is quite appropriate that the first use of *lithos chytê* should be in connection with that country. Herodotus² says that about Thebes and Lake Moeris the people had sacred crocodiles which they adorned with earrings of glass and gold. The use of glass to imitate gems would be one of the simplest. Since *hyalos* occurs side by side with *lithos chytê*, the latter may have stood for some special variety. Possibly Plato (*S.* V/IV)³ was thinking both of glass and some particular form of it, such as paste gems, when he uses the expression, "all the kinds of stone that are called molten," listing them together as having less water than earth, among the things subject to the liquifying effect of fire. Although this expression does not occur frequently in literature, it must have been fairly well established, for the last mention of it occurs over two centuries after the first. Perhaps Epinicus (*S.* III)⁴ considered a goblet of 'molten stone' more suitable for poetry than one of *hyalos*, which was certainly a more common term by his time.

Sometimes glass was called simply *lithos* (fem.), 'stone.' That appellation may have arisen later as an abbreviation of *lithos chytê*, or simply like the longer expression because of the resemblance of glass to natural substances of a vitreous appearance. In Aristophanes' *Clouds*⁵ Strepsiades asks of Socrates, "Have you ever seen at the druggists' that stone, the beautiful, the transparent one, by which they kindle fire?" Socrates queries, "You speak of the *hyalos*?" To be sure, the nature of glass was not very well understood as yet, and *hyalos*, by which it was later universally known, was sometimes applied to other transparent substances. However, there is no par-

² 2, 69: ἐκ πάντων δὲ ἓνα ἑκάτεροι τρέφουσι κροκόδειλον δεδιδαγμένον εἶναι χειροθήρα, ἀρτήματά τε λίθινα χυτὰ καὶ χρύσεια ἐς τὰ ὦτα ἐνθέντες.

³ *Tim.* 61B: τὰ μὲν ἔλαττον ἔχοντα ὕδατος ἢ γῆς τό τε περὶ τὴν ὕαλον γένος ἅπαν ὅσα τε λίθων χυτὰ εἶδη καλεῖται.

⁴ *Apud Athen.* 10, 432C: γέροντα Θάσιον τὸν τε γῆς ἀπ' Ἀθίδος | ἐσμὸν μελίσσης τῆς ἀκραχόλου γλυκὺν | συγκυρκανήσας ἐν σκύφῳ χυτῆς λίθου.

⁵ *Nub.* 766ff.: ΣΤΡ. ἤδη παρὰ τοῖσι φαρμακοπώλαις τὴν λίθον | ταύτην ἐόρακας, τὴν καλὴν, τὴν διαφανῆ, | ἀφ' ἧς τὸ πῦρ ἄπτουσι; ΣΩΚ. τὴν ὕαλον λέγεις; Blaydes, *Aristophanes' Nubes* (1890), 101, n. 767, has amended καλὴν to χυτὴν without any substantial justification. Cf. p. 179, n. 6.

ticular reason to think that the burning-glass was of crystal⁶ here. To be sure, it is called a stone,⁷ but that does not suggest a crystal any more than it does the other name for glass. In the *Periplus* of Scylax (*S.* IV)⁸ the Phoenicians are described as taking the 'Egyptian stone' to the West Africans. From the first the Greeks seemed to connect the manufacture of glass with Egypt, and it is not surprising that it should be called simply the 'Egyptian stone.' Gems and other trifles of glass would be most profitable for trade among less civilized peoples.⁹ Four centuries later, in the *Periplus of the Red Sea* the Egyptians are spoken of as exporting to the Berbers many kinds of *lithia hyalê*¹⁰ made at Diospolis. In one instance they are called simply *lithia*.¹¹ From the diminutive form doubtless the nature of the articles of trade is indicated. Probably there is a reference to the making of glass in Bekker's *Lexica*,¹² where he calls an oven "a contrivance in which earthenware and stone (*lithos*) are baked."

Sometimes *lithos chytê* is said to be an older name for *hyalos*.¹³ It is not employed before Herodotus, who also speaks of *hyalos*, although he could not have used the latter of actual glass. Before his time, however, Corinna (*S.* VI/V) used the adjectival form of *hyalos*, and very soon the word occurs with the meaning 'glass.' It is true that *lithos chytê* appears first in literature later than *hyalos*, but the two words are used at the same time and occur side by side. The real reason for thinking that *lithos chytê* is the older expression

⁶ To be sure there is a gloss on v. 766 in R and V τὴν λίθον· τὸν κρύσταλλον, but this is ambiguous, for κρύσταλλος seems occasionally to have been used for glass (see below, p. 53); among the Romans *crystallum* must often mean nothing more than glass, see Blümner, *Tech. u. Term.* 4, 386, while the more elaborate scholia in R and V on v. 768 speaks unequivocally of glass, and with this view the opinion of modern scholars agrees, see Blümner, *op. cit.* 4, 383, 4; Kisa, *op. cit.* 1, 166.

⁷ Salmas. *Plin. Exercit.* 773bA: "nec impedimento est quod λίθον vocat. auctores passim vitrum sic appellant. auctor peripli λιθίαν ὑαλὴν ubique vocat. quae alibi eidem dicitur ὑελος ἀργή. inde et κρύσταλλος glacies, quam vocem pro vitro etiam quidam usurparunt."

⁸ 112 (Müller, *Geog. Gr. Min.* 1, (1855)): οἱ δὲ Φοίνικες ἔμποροι εἰσάγουσιν αὐτοῖς μύρον, λίθον Αἰγυπτίαν, ἄπρους ἐξαράκτους, κέραμον Ἀττικὸν καὶ χοῦς.

⁹ Blümner, *Tech. u. Term.* 4, 381f.

¹⁰ 6(ed. Fabricius, 1883): προχωρεῖ δ' εἰς τοὺς τόπους ἱμάτια βαρβαρικά ἄγναφα τὰ ἐν Αἰγύπτῳ γινόμενα . . . καὶ λιθίας ὑαλῆς πλείονα γένη καὶ ἄλλης μουρρίνης τῆς γινομένης ἐν Διοσπόλει. 7: προχωρεῖ δ' εἰς αὐτὴν ὑαλὴ λιθία σύμμικτος. 17: καὶ λιθίας ὑαλῆς πλείονα γένη.

¹¹ *Ibid.* 10: προχωρεῖ δ' εἰς αὐτὸ τὰ προειρημένα γένη καὶ σκεύη ἀργυρᾶ, σιδηρᾶ δ' ἐλάσσονα, καὶ λιθία.

¹² 5, 270: κάμινος: τὸ κατασκεύασμα, ὅπου ὀπτᾶται ὁ κέραμος καὶ λίθος.

¹³ Kisa, *op. cit.* 164.

is that it is a primitive, descriptive term, while *hyalos* is a shorter, more direct technical expression. Probably the Greeks were at first most familiar with glass in the form of small objects, like gems, beads, and other trifles, which are so easily exported. It is possible that, when glass became more common, *hyalos* expanded to embrace all of its forms and varieties, while *lithos chytê* was still generally applied to the small objects for which it first stood, and in the shorter form of *lithos* or *lithia* it continued to be used for these articles of barter. Yet the case of the goblet shows that it too had broadened its meaning somewhat. In literature, however, there was never a time when *lithos chytê* was as common as *hyalos*, to which it eventually gave way entirely.¹⁴

C. *Hyalos*

I. ETYMOLOGY

With the introduction of transparent glass there came a new designation, *hyalos*, the origin of which is unknown. It is derived from *hyein*, 'to rain,' by the Greek lexicographers and etymologists.¹ Salmasius notes this derivation and considers that *hyalos* with the meaning 'wet' would be used in the sense of 'bright,' 'clear,' since objects which are wet are bright and shiny.² Some modern etymologists consider the derivation from *hyein* probable,³ notably Curtius, who says that "the substantive probably meant properly 'rain-drop.' " Froehner thinks that it is more probably from *hals*,

¹⁴ ἡ λίθος or ἡ λίθος χυτή as a designation for glass probably passed out of general use soon after the introduction of a technical term which was not so liable to ambiguity, for ἡ λίθος was commonly employed to denote precious stones in general and in particular often means 'the magnet' (ἡ λίθος, sc. Μαγνήτης).

¹ Orion (ed. Sturz): ὑάλῃ ὑαλος, παρὰ τὸ ὑεῖν ἐσχημάτισται, καθ' ὁμοιότητα τῆς γινομένης συστάσεως, καὶ πήξεως τοῦ ὕδατος, ὑάλῳ ὁμοίως. Ἡρακλείδης. *Etym. Gud.* 358, omits merely the last word. Zonar. *Lex.* 1760: παρὰ τὸ ὑεῖν καὶ καθ' ὁμοιότητα εἶναι τῆς γινομένης συστάσεως καὶ πήξεως (μίξεως D. K.) τοῦ ὕδατος. *Etym. Magn.* 774: ὑαλος . . . ἐτυμολογεῖται δὲ παρὰ τὸ ὑεῖν . . . ὁμοίως. Miller, *Mélanges*, 290: ὑαλος . . . παρὰ τὸ ὑεῖν καθ' ὁμοιότητα, κτλ.

² *Plin. Exercit.* 771aF: "Graecis ὑεῖν est madidare, et humectare, βρέχειν, ὑγραίνειν. inde ὑαλον, humectum. sed et quae madidata sunt et aqua aspersa, ea lucent nitentque, ex eo factum, ut etiam ὑαλον pro lucido sumeretur. Hesych. ὑαλον λαμπρόν, etc. postea proprium hoc nomen factum vitri."

³ Sonne (*Kühns Zeitschr.* 12 (1863), 359). Curtius, *Gr. Etym.* ed. 5, 604 (Trans. by Wilkins and England): "Root ὑ ὑ-ει it rains, ὑ-ε-τό-ς rain. Skt. *su* (*su-nó-mi*) press out juice, *sū-má-m* milk, water, sky We may with some probability place here also ὑαλος, ὑελος." Prellwitz, *Etym. Wörterb.* ed. 2 (1892), 473: "ὑάλεος, ὑάλιος gläsern, 'wasserkklar': ὕω." *Thes. Gr. Ling.* 8, 7.

'salt,' the upsilon standing for an old digamma.⁴ Blümner thinks it was a foreign word.⁵ Some would derive it from the Coptic,⁶ because the first mention of glass in Greek is in connection with the Egyptians. Others try to find some connection with the Latin *vitrum*,⁷ 'glass,' or the element *sualo*-*'transparent stone'* or the like.⁸

2. APPLICATION OF *Hyalos*

Whatever may be the source of the word *hyalos*, it seems to have meant transparent, or at least translucent, glass. Since the word was new and the substance which it designated rather unfamiliar, it is not strange that it should be applied to other substances of a vitreous appearance. That is just what happens in the first instance where the substantive occurs in literature. To be sure, the use of the adjectival form, *hyalinus*, by Corinna (*S.* VI/V)¹ implies an earlier use of *hyalos* than those recorded, but unfortunately the passage from Corinna is so obscure that we can learn nothing about glass from it. In Herodotus (*S.* V) there is a description of coffins of *hyalos* among the marvels shown by the Aethiopians to the spies of Cambyses. "And after this, last of all, they saw their coffins, which are said to be made of *hyalos* in the following manner: when they have dried the body of the dead, either according to the Egyptian or some other fashion, they cover it entirely with gypsum and decorate it with painting, making it as nearly like the figure of the person as possible, and then they put about it a block of *hyalos* which has been hollowed out (they dig up a quantity of this of a kind easily worked). The corpse is in the middle of the block and

⁴ Froehner, *La Verrerie*, 6: "J'aimerais mieux prendre la voyelle *v* pour un ancien digamma, ce qui nous remènerait au sel minéral (*ἄλς*). Et cette étymologie n'est pas si maladroite, car le verre est une espèce de sel; des chimistes autorisés l'ont ainsi défini." This conjecture seems the most probable to Morin-Jean (Daremberg-Saglio, *Dict. des Ant. Gr. et Rom.* 5 (1912), 935) and Kisa, *op. cit.* 3, 24, but it implies a knowledge of chemistry on the part of the early Greeks which is altogether improper for one to assume. There is, however, considerable resemblance between semi-transparent rock-salt, and glass, but even this would scarcely justify the suggested etymology.

⁵ *Glas* (P.-W. 7, 1385).

⁶ *Thes. Gr. Ling.* 8, 9: "ὑαλος fortasse ortum ex Aegyptiaco ουαλ s. ουιαλ, quod Lapidem, pellucidum, non vero proprie Vitrum nostrum significat. Jablonsk, *Opusc.* 1, p. 250." Becker, *Gallus*, ed. 2 (1880), Ex. 1 on Scene 7.

⁷ L. Meyer, *Handb. d. gr. Etym.* 2 (1901), 141: "Dunklen Ursprungs. Denkbar wäre ein Zusammenhang mit lat. vitro-(vitrum) 'Glas.'"

⁸ Boisacq, *op. cit.* 996.

¹ Phryn. 309: καὶ ἡ Κόριννα τὸν ὑάλινον παῖδα θήσεις.

can be seen through it, but it does not produce an unpleasant odor or anything else unseemly, and it has everything visible like the corpse itself. For a year those most closely related keep the block in their houses giving it the first fruits of everything and offering sacrifices to it. And after these things they take it out and place it near the city."² This passage has caused not a little perplexity. All are agreed that *hyalos* does not mean glass, but the substance for which it does stand is uncertain.³ Although this whole account is probably fabulous,⁴ it shows that Herodotus applied *hyalos* to a transparent material which was dug out of the ground, and also that the Egyptians or rather Aethiopians perhaps occasionally used some transparent substance about their dead. Ctesias⁵ attests such a use, but his authority is very slight to begin with, and besides it is impossible to tell whether he meant that the Aethiopians used actual glass or not, for Diodorus by whom this passage has been preserved may have misrepresented him as much as he has Hero-

² 3, 24: μετὰ δὲ ταύτην τελευταίας ἐθεήσαντο τὰς θήκας αὐτῶν, αἱ λέγονται σκευάζεσθαι ἐξ ὕαλου τρόπῳ τοιῷδε· ἐπεὰν τὸν νεκρὸν ἰσχυρήνωσι, εἴτε δὴ κατὰπερ Αἰγύπτιοι εἴτε ἄλλως κως, γυψώσαντες ἅπαντα αὐτὸν γραφῇ κοσμέουσι, ἑξομοιῶντες τὸ εἶδος ἐς τὸ δυνατόν, ἔπειτα δὲ οἱ περιστάσι στήλην ἐξ ὕαλου πεποιημένην κοίλην (ἡ δὲ σφί πολλὴ καὶ εὐεργὸς ὀρύσσεται)· ἐν μέσῃ δὲ τῇ στήλῃ ἐνεῶν διαφαίνεται ὁ νέκυς, οὔτε ὁδμὴν οὐδεμίαν ἄχαριν παρεχόμενος οὔτε ἄλλο ἀεικὲς οὐδέν· καὶ ἔχει πάντα φανερά ὁμοίως αὐτῷ τῷ νέκυϊ. ἐνιαυτὸν μὲν δὴ ἔχουσι τὴν στήλην ἐν τοῖσι οἰκίοισι οἱ μάλιστα προσήκοντες πάντων τε ἀπαρχόμενοι καὶ θυσίας οἱ προσάγοντες· μετὰ δὲ ταῦτα ἐκκομίσαντες ἰσθᾶσι περὶ τὴν πόλιν.

³ Belzoni, *Researches*, 236 (quoted in *Thes. Gr. Ling.* 8, 8): "Oriental alabaster." *Thes. Gr. Ling.* 8, 8: "Crystal." Rawlinson, *Herodotus*, 2 (1860), 350, 1: "It should be rock crystal; but no piece of this substance could be found large enough to hold a body. It may have been some vitreous composition coating the coffins in the form of a mummy, some of which are found in Egypt." Compare Sayce, *Herodotus*, 1-3 (1883), 240, 7. Abicht, *Herodotus*, ed. 3, 2 (1862), 26: "Vielleicht eine Art Steinsalz." Vaniček, *Gr.-Lat. Etym. Wörterb.* (1877), 1046: "Glasporzellan." Blümner, *Tech. u. Term.* 4, 384: "Ein natürliches, aus der Erde gegrabenes Material." Note 1: "Die Erklärer denken an durchsichtiges Glasporzellan, andere mit mehr Wahrscheinlichkeit an Bergkrystall." Liddell and Scott, *s. v.*: "Some kind of clear, transparent stone."

⁴ Niebuhr, *Vorträge über alte Gesch.* 1, 151; Rawlinson, *op. cit.*, 2, 350, 2; Howells, *A Comm. on Herodotus*, 1 (1912), 240, 7.

⁵ Diod. 2, 15, 2ff.: Κτησίας δ' ὁ Κνίδιος ἀποφαινόμενος τοῦτον σχεδιάζειν, αὐτὸς φησι τὸ μὲν σῶμα ταριχεύεσθαι, τὴν μέντοι γε ὕελον μὴ περιχεῖσθαι γυμνοῖς τοῖς σώμασι· κατακαυθῆσεσθαι γὰρ ταῦτα καὶ λυμανθέντα τελῶς τὴν ὁμοιότητα μὴ δυνήσεσθαι διατηρεῖν. διὸ καὶ χρυσὴν εἰκόνα κατασκευάζεσθαι κοίλην, εἰς ἣν ἐντεθέντος τοῦ νεκροῦ περὶ τὴν εἰκόνα χεῖσθαι τὴν ὕελον· τοῦ δὲ κατασκευάσματος τεθέντος ἐπὶ τὸν τάφον διὰ τῆς ὕελου φανῆναι τὸν χρυσὸν ἀφωμοιωμένον τῷ τετελευτηκότι.

dotus.⁶ Diodorus (*S. I*) interprets *hyalos* as actual glass which was poured about the dead. He says that they made so much of it in Aethiopia that there was enough for every one.⁷ Strabo (*S. I*) is probably taking the word of an earlier writer when he says of the Aethiopians, "some pour *hyalos* about the dead and keep them at home."⁸ In another place, he speaks of the body of Alexander having been transferred from a gold to a glass sarcophagus.⁹ Aelian (*S. 2*)¹⁰ relates how Xerxes found the body of Belus in a glass sarcophagus full of oil. Such stories sound extremely fabulous. Lucian (*S. 2*)¹¹ ascribes to the people of India the practice of smearing the dead with *hyalos*,¹² an expression which surely suggests a substance other than glass. The Pseudo-Callisthenes (*S. 3*)¹³ describes the body of Cyrus in a coffin with glass poured about it. The Latin version of the passage by Julius Valerius¹⁴ where the coffin is described, uses the expression *lapide visendo*, 'of transparent stone.' There seems to have been a custom among the Egyptians, Aethiopians, and other Eastern nations of covering the bodies of the dead or the cases in which they were enclosed with something transparent, called *hyalos*. This could not have been a stone, for it was 'smeared,' or 'poured'; nor could it have been glass or even a glaze, because

⁶ *Ibid.* 2, 15, 1: ταφὰς δὲ τῶν τελευτησάντων ἰδίως οἱ κατὰ τὴν Αἰθιοπίαν ποιοῦνται· ταριχεύσαντες γὰρ τὰ σώματα καὶ περιχέαντες αὐτοῖς πολλὴν ὕλον ἱστᾶσιν ἐπὶ στήλης, ὥστε τοῖς παριούσι φαίνεσθαι διὰ τῆς ὕλου τὸ τοῦ τετελευτηκότος σῶμα, καθάπερ Ἡρόδοτος εἴρηκε.

⁷ *Ibid.* 2, 15, 4: τὴν δὲ ὕλον πᾶσιν ἑξαρκεῖν διὰ τὸ πλείστην γεννᾶσθαι κατὰ τὴν Αἰθιοπίαν καὶ τελῶς παρὰ τοῖς ἐγχωρίοις ἐπιπολάζειν.

⁸ 17, 2, 3: τοὺς δὲ νεκροὺς οἱ μὲν εἰς τὸν ποταμὸν ἐκρίπτουσιν, οἱ δ' οἴκοι κατέχουσι περιχέαντες ὕalon.

⁹ *Ibid.* 17, 1, 8: τὸ δὲ σῶμα τοῦ Ἀλεξάνδρου κομίσας ὁ Πτολεμαῖος ἐκήδευσεν ἐν τῇ Ἀλεξανδρείᾳ ὅπου νῦν ἔτι κεῖται· οὐ μὴν ἐν τῇ αὐτῇ πυλῶν ὕalινη γὰρ αὕτη, ἐκεῖνος δ' ἐν χρυσῇ κατέθηκεν.

¹⁰ *Var. Hist.* 13, 3: Ἐέρξης ὁ Δαρείου παῖς τοῦ Βήλου τοῦ ἀρχαίου διασκάψας τὸ μνῆμα πέλον ὕalινην εὔρεν, ἔνθα ἦν κείμενος ὁ νεκρὸς ἐν ἐλαίῳ.

¹¹ *De Luctu*, 21: Ἰνδὸς ὕalῳ περιχρίει.

¹² Wallace-Dunlop, *Glass in the Old World* (1883), 24: "In the word *hyalos* the Greeks seem to have included not only glass but everything that was of a crystalline colour, as pellucid bodies such as ice, and even gums, as Lucian uses the same word in describing the Indians anointing their dead with balsamic gums."

¹³ 2, 18: παραπλήσιον δὲ ἐθεάσατο καὶ τὸν Κύρου τάφον· ἦν δὲ πύργος αἰθριος δωδ' ἐκάστεγος, ἐν δὲ τῇ ἄνω στέγῃ ἔκειτο αὐτὸς ἐν χρυσῇ πυλῇ, καὶ ὕelos περιεκέχυτο αὐτῷ, ὥστε τὸ τρίχωμα αὐτοῦ φαίνεσθαι καὶ αὐτὸν δὲ ὅλον διὰ τοῦ ὕλου.

¹⁴ Ps. Callisth. 2, 18: ipsius vero Cyri conditorium erat lapide visendo, cuius sive natura perspicua, sive inscaltio adeo tenuis erat, ut nihilo prorsus quicquid interesset impediret intuentium diligentiam, adeo ut propter saxi illius evidentiam capilli etiam conditi cadaveris viserentur.

that cannot be poured except at such a temperature that it would utterly disfigure any corpse. If we are to believe any part of the accounts at all, we must think of a transparent varnish, shellac, or lacquer. Some authors no doubt wittingly called a substance which was not glass *hyalos*, while others perhaps mistook a substance vitreous in appearance for real glass, or finally, a foreign word may either have been mistaken for glass, or else it may have been used generally of several transparent, glistening substances, including glass, and the Greek authors were not aware of this fact. In any case this tradition does not deal with glass as we know it.

Although the *hyalos*, the burning-glass kept at the druggist's shop, in the *Nubes* of Aristophanes, was probably of glass, a scholiast has interpreted it as crystal.¹⁵ This shows that the scholiast, at least, thought that *hyalos* might designate crystal. Achilles Tatius (*S.* 4?) seems to indicate rock-crystal when he describes a cup of *hyalos orôrygmenê*, 'glass that has been mined.' About the cup was a vine from which hung grapes so skilfully engraved that when the cup was empty, they looked unripe, but when it was full of wine, they looked red and ripe.¹⁶ After finding *hyalos* used in such a way, it does not seem strange that Pollux (*S.* 2/3) should list it among the things that are mined.¹⁷ Moreover, in the alchemical writings glass is classed with metals like silver, under the sign of the moon.^{17a}

The first certain use of *hyalos* or any of its derivatives in the meaning of 'glass' seems to be in Aristophanes (*S.* V),¹⁸ for *hyalinós* in Corinna and *hyaloëides* in Philolaus and Ion of Chios, although probably designating ordinary glass, cannot, because of their employment in mere comparisons, be regarded as unequivocally presupposing at that time the application of *hyalos* to glass rather than to crystal or some other transparent precious stone, but those who think that the burning-glass was made of crystal mention

¹⁵ Schol. on Aristoph. *Nub.* 766; see below, p. 178, n. 2.

¹⁶ 2, 3: ὑάλου μὲν τὸ πᾶν ἔργον ὀρωρυγμένης: κύκλῳ δ' αὐτὸν ἄμπελον περιέστεφον ἀπὸ τοῦ κρατήρος πεφυτευμένοι. οἱ δὲ βότρυνες πάντῃ περικρεμάμενοι· ὄμφαξ μὲν αὐτῶν ἕκαστος ὅσον ἦν κενὸς ὁ κρατήρ· ἐὰν δ' ἐγγέης οἶνον, κατὰ μικρὸν ὁ βότρυνς ὑποπερκάζεται καὶ σταφυλὴν τὴν ὄμφακα ποιεῖ. Διόνυσος τ' ἐντετύπεται τῶν βοτρυῶν, ἵνα τὴν ἄμπελον γεωργῇ. See Semper, *Der Stil*, ed. 2, 2 (1863), 197.

¹⁷ 3, 87: χρυσός, ἄργυρος, ὀρείχαλκος, σίδηρος, καττίτερος, μόλυβδος, ὕαλος.

^{17a} *Planetary List of the Metals*, 7 (Berthelot, *Collection des Anciens Alchimistes Grecs* (1887), 25): ἄργυρας· ὕελος· στίμμι· ζινίχια· χάνδρα· γῆ λευκή, καὶ τὰ ὅμοια. See *Hist.* 1, 86, 312, 327, 333, 345; 2, 126; 3, 187.

¹⁸ *Nub.* 768. Compare *Ach.* 74: ὑάλινα ἐκπώματα.

Plato (*S. V/IV*)^{18a} as the first to apply *hyalos* to actual glass.¹⁹ Although its use was rather uncommon at first, in time it became so well known that *hyalos* alone was employed to designate a glass vessel.²⁰ The chief characteristic of *hyalos*, 'glass,' as might be expected from its application to other substances of a vitreous appearance, was transparency. Not only was its transparency frequently mentioned or inferred,²¹ but it was used as a standard with which to compare anything else which is transparent.²² It

^{18a} *Tim.* 61B.

¹⁹ *Thes. Gr. Ling.* 8, 7.

²⁰ See below, p. 153, 3.

²¹ Arist. *Problem.* 11, 905B, 6, 25: 939A, 13: *Analyt. Post.* 1, 31, 88A, 14. Hero, *Definitiones*, 4, 102, 16: καὶ καθ' ἕτερον δὲ τρόπον ὑποτίθεται τὰ μὲν δι' αἰθέρος καὶ αἰέρος ὁρώμενα κατ' εὐθείας γραμμὰς ὁρᾶσθαι· φέρεσθαι γὰρ πᾶν φῶς κατ' εὐθείας γραμμὰς· ὅσα δὲ διαφαίνεται δι' ὑέλων ἢ ὑμένων ἢ ὕδατος, κατὰ κεκλασμένας, τὰ δὲ φαινόμενα ἐν τοῖς κατοπτρίζουσι κατὰ ἀνακλωμένας [γωνίας]. 106, 3: ὅποια γὰρ ἡ τῶν ὀψεων πρόπτωσις, τοιοῦτος καὶ ὁ καταφωτισμός ὑπὸ τοῦ ἡλίου γίνεται, καὶ τότε μὲν κατ' εὐθείας ἀκλάστους, τότε δὲ κατὰ δυομένας, ὥσπερ ἐπὶ τῶν ὑέλων. 106, 10: ἡ δ' ἐπὶ τῶν ὑδάτων καὶ τῶν ὑμένων τὰ κατὰ διάδυσιν θεωροῦσα ὀπτική ἐλάττω μὲν θεωρίαν ἔχει, αἰτιολογεῖ δὲ τὰ ὑπὸ τοῖς ὕδασι καὶ ὑμέσι καὶ ὑέλοις, ὅποτε διασπαρτθώμενα φαίνεται τὰ ἡνωμένα καὶ σύνθετα τὰ ἀπλὰ καὶ τὰ ὀρθὰ κεκλασμένα καὶ τὰ μένοντα κινούμενα. *Idem*, *de Speculis*, 3: in aquis autem in vitris <non> omnes refringuntur . . . per vitrum enim et per aquas videmus nos ipsos et ultra iacentia. in palustribus enim aquis que in fundo videmus et per vitra ea que ultra iacent. Alex. Aphrod. on Arist. *de Anima*, 138, 28: γελοῖον γὰρ τοι τὸν μὲν λίθον τὸν διαφανῆ ἢ τὴν ὕαλον μὴ λέγειν εἶναι σῶμα, τὸ δὲ φῶς λέγειν. 149, 26: ἡ δὲ ὕαλος καὶ τὰ διαφανῆ, οἷς τοὺς οἴκους φράττουσιν, ὕδατός ἐστιν, ὥς δῆλον ἐκ τῆς γενέσεως αὐτῶν. *Idem* on Arist. *Metaphysica*, 588, 40: ὥσπερ εἴ τις ἐν κηρῷ πλάσας εἰδὸς τι κήρινον καὶ ἐκτός ἐπιθεῖς ὕελον ἢ ἄλλο τι τῶν διαφανῶν, ὁρᾶται τὸ ἐντὸς αὐτῆς κήρινον εἶδος. Damascius, *Dubitaciones et Solutiones* (ed. Ruelle, I (1889), 183, 11): ὥς εἰ λέγοις ὕαλον ἥτοι τῶν διαφανῶν ὅλον ὁρατόν. Philoponus on Arist. *de Anima*, 319, 15: ἔπειδὴ οὖν ἐν τῷ ὀρισμῷ τοῦ χρώματος ἐμνήσθη τοῦ διαφανοῦς διδάσκει ἡμᾶς, τί ποτέ ἐστι τὸ διαφανές, ὅτι φύσις τίς ἐστιν ἐν πλείοσιν ὑπάρχονσα, ἐν ὕδατι, ἐν ἀέρι, ἐν ὑέλῳ καὶ ἐν ἐτέροις, διαπορθμευτική τῶν χρωμάτων, ἥτις φωτὸς μὲν μὴ παρόντος, δυνάμει ἐστὶν αὐτὸ τοῦτο διαφανές, ἐνεργείᾳ δὲ γίνεται διαφανές φωτὸς παρόντος. 320, 26: σημεῖον δὲ τοῦτου, ὅ τι εἰ ὑέλου ἢ διαφανοῦς λίθου μία ἐπιφάνεια χρωσθεῖη. *Idem* on Arist. *Meteor.* 44, 1: ἔπειτα πολλοὶ τῶν στερεμνωτάτων λίθων εἰσὶ διαφανέστατοι καὶ ἡ ὑελος . . . ὁρᾶται γὰρ τὰ ἐκ τούτων τριβόμενα καὶ μάλιστα τὰ ἐξ ὑέλου σχεδὸν ἐκπυρούμενα τῇ θερμότητι. Suid. 1319, 18: διαφανές· ἔστι δὲ διαφανῆ οὐκ ἄρῃ μόνον καὶ ὕδωρ ἀλλὰ καὶ πολλὰ τῶν στερεῶν σωμάτων· οἷον φεγγῆται λίθοι, κέρατα, ὑελος, γύψος καὶ ἕτερα. Nemesius, *de Natura Hominis* (*Patr. Gr.* 40, 645B) ἥττον δὲ διὰ ὑέλου καὶ τῶν ἄλλων τῶν τοιοντοτρόπων, δῆλον δέ, ὅ τι πεφωτισμένον. Transparency is mentioned frequently in connection with glass objects which will be spoken of later.

²² Topaz is compared to glass, Agatharchides, *de Mari Erythr.* (Müller, *Geog. Gr. Min.* I (1855), 170) in Photius: ἐν δὲ ταύτῃ γίνεται τῇ νήσῳ, φησί, καὶ τὸ καλούμενον τοπάσιον. ἔστι δὲ τοῦτο λίθος διαφανόμενος, ὑάλῳ (γάλῳ BA) προσεμφερής, ἡδεῖαν ἔγχρυσον θεωρίαν ἀποδιδούς. In Diodorus, 3, 39, 5: εὐρίσκεται γὰρ ἐν τῇ

even developed a figurative meaning with which moral qualities might be compared.²³ It is to molten glass more frequently than to merely transparent glass that the physicians compare the vitreous humor of the eye,²⁴ and humors of the body.²⁵ Some of its other characteristics are brightness,²⁶ solidity,²⁷ brittleness,²⁸ and possibly smoothness.²⁹

νήσω ταύτη τὸ καλούμενον τοπάσιον, ὅπερ ἐστὶ λίθος διαφαινόμενος ἐπιτερπής, ὑάλω παρεμφερής. Psellus, *de Lap.* 25: τοπάσιον λίθος ἐστὶ διαφανής, ὑέλω παρεμφερής. The city and the streets of Heaven are compared to pure or transparent glass. Here the idea of brightness as well as transparency seems to exist. *Rev.* 21, 18: καὶ ἡ πόλις χρυσίον καθαρὸν ὅμοιον ὑάλω καθαρῷ. *Idem.* 21, 21: καὶ ἡ πλατεία τῆς πόλεως χρυσίον καθαρὸν ὡς ὕαλος διαυγής. Andreas Caesar (*Patr. Gr.* 106. 437) on *Rev.* 21, 21: καὶ ἡ πλατεία τῆς πόλεως, χρυσίον καθαρὸν ὡς ὕαλος διαυγής . . . διὰ τὴν πλατεῖαν τῆς πόλεως, διὰ μὲν τὸ πολυτελὲς καὶ εὐχρουν, ὡς χρυσίον, διὰ δὲ τὸ καθαρὸν, ὡς κρυστάλλου ἐθεάσατο, [ἢ τοι ὡς ὕαλον διαυγῇ] ἅπερ ἀμφότερα ἐν ἐνὶ συνδραμεῖν παρ' ἡμῖν, ἀδύνατον. Of the joinings of the bones, *Anaphora Pilati*, 2 (ed. Tischendorf, *Evangel. Apoc.* (1853), 422): καὶ γυναῖκα αἰμορροοῦσαν ἐπὶ χρόνοις πολλοῖς, ὡς ἐξ αὐτῆς τῆς ῥύσεως τοῦ αἵματος πᾶσαν τὴν τῶν ὀστέων ἁρμονίαν φαίνεσθαι καὶ ὑέλων δίκην διανύζειν. Of bubbles in raindrops, Alex. Aphrod. *Problem.* 2, 39: καθάπερ καὶ τὴν ὕαλον ἔστιν ἰδεῖν ὑπὸ τοῦ πνεύματος φυσωμένην, καὶ πᾶν ὑγρὸν ἐν τῇ ἐψήσει πνευματούμενον. Of skin, *Ibid.* 2, 4: τῇ δὲ λεπτότητι τοῦ δέρματος ὥσπερ δ' ὑέλων ἐμφαίνει τὸ εὐανθὲς τοῦ χρώματος. Rufinus (*Anth. Pal.* 5, 36): τῆς δὲ Ῥοδοκλείης ὑάλω ἴσος, ὑγρομέτωπος, | οἷα καὶ ἐν νηφῷ πρωτογλυφὲς ξόανον. There is a clear, thin skin which looks almost transparent.

²³ Photius, *Myriobiblon*, 275 (*Patr. Gr.* 104, 244A): ὅτι, φησὶν, αἱ ἱστορίαι τὴν Μαγδαληνὴν ταύτην διὰ βίου παρθένον διαδάσκουσι. καὶ μαρτύριον δὲ αὐτῆς φέρεται, ἐν ᾧ λέγεται διὰ τὴν ἄκραν αὐτῆς παρθενίαν καὶ καθαρότητα ὡς ὕαλον αὐτὴν καθαρὸν ταῖς βασανισταῖς φαίνεσθαι.

²⁴ Galen, 3, 761: τὸ ὑαλοειδὲς ὑγρὸν, καὶ ὅσῳ παχύτερον καὶ λευκότερον αἵματος ἐστὶ, τοσοῦτον τοῦ κρυσταλλοειδοῦς ὑγροῦ ἀπολειπόμενον ὑγρότητί τε καὶ φανότητι. τὸ δ' ὑαλοειδὲς ὑγρὸν μὲν, ὥσπερ τις ὕαλος ὑπὸ θερμοῦ κεχυμένη. Aetius, *Ἱατρικά*, 7 (in the edition, *Die Augenheilkunde* (1899), ed. Hirschberg): ὑγρά δὲ ἔστιν ἐν τῷ ὀφθαλμῷ τρία· ἔνδοθεν μὲν πάντων τὸ περιεχόμενον ἐν τῇ κοιλότητι τοῦ ἀμφιβληστροειδοῦς χιτῶνος ὑελοειδὲς λεγόμενον· προσέοικε γάρ, καὶ τῇ χροίᾳ καὶ τῇ συστάσει, τῇ κεχυμένῃ ὑέλῳ· τούτου δὲ ἐξωτέρῳ κείται κατὰ τὸ πέρασ τοῦ ἀμφιβληστροειδοῦς χιτῶνος τὸ κρυσταλλοειδὲς ὑγρὸν, ὃ καὶ δισκοειδὲς καὶ φακοειδὲς καλεῖται· προσέοικε γὰρ τῇ μὲν χροίᾳ κρυστάλλῳ τῷ δὲ σχήματι φακῷ ἔξωθεν δὲ περιέχεται τούτῳ τὸ ὠοειδὲς ὑγρὸν. προσέοικε γάρ, τῇ χροίᾳ καὶ τῇ συστάσει, τῷ ἐν τοῖς ὠοῖς ὑγρῷ τῷ λευκῷ καὶ λεπτῷ· τὸ μὲν οὖν πάντων ἔνδοθεν τὸ ὑελοειδὲς ὑγρὸν πρὸς τὸ τρέφειν τὸ κρυσταλλοειδὲς παρασκευάζεται.

²⁵ Galen, 7, 138: τοιοῦτον δὲ ἐστὶ παραπλήσιον ὑάλῳ κεχυμένην κατὰ τε τὴν χροάν καὶ τὴν σύστασιν, ὃν περ δὴ καὶ ὑαλώδη χυμὸν οἱ περὶ τὸν Πραξαγόραν τε καὶ Φιλότημον ὀνομάζουσιν. 7, 348: ὁ χυμὸς οὗτος ὑάλῳ κεχυμένη· 8, 81: τὸν ὑαλώδη προσαγυρεῖνόμενον ὑπὸ Πραξαγόρου χυμὸν, ὃς ὑάλῳ κεχυμένη προσέοικεν τὴν χροίαν καὶ τὴν σύστασιν. 16, 367; 585. Orib. (Bussemaker-Daremborg, 5 (1873), 550, from Galen): ἔστι δὲ παχὺς οὗτος ὁμοῖος πον ὑάλῳ κεχυμένην τῷ πάχει.

²⁶ *Rev.* 21, 18 and 21. Suid.: ἐνδιος· μεσημβρινός· “ὄφρα μὲν οὖν ἐνδιος ἔην ἔτι, θέρμετο δὲ χθών, τόφρα δ' ἔην ὑάλιο φαάντερος οὐρανός ἦν οὖψ,” τοῦτέστιν ὁ λαμπρός.

Even after *hyalos* came to be the universal name for glass, it was still occasionally applied to other substances. Possibly it stands for a diamond in a puzzling letter of the early fourth century found among the papyri of the Fayum towns. "Eudaemon to Longinus, greeting. I entreat you, sir, to hasten to me and bring, if you please, the crystal (?) and we will clip the cash. If you . . . , you will be able to strain me some good Mareotic wine when you come, with the value. Good-bye."³⁰ The editors think that *hyalos* is "here a stone implement of some kind for clipping coins, in order that the writer might get some wine with the proceeds of this (nefarious) transaction." On the other hand, Bücheler gives an entirely different interpretation. He considers that this is not an evil scheme, but a jesting imitation of invitations found in the poets.³¹ Perhaps Eudaemon merely wanted Longinus to bring a glass for his wine. Instances have been given of the use of *hyalos* alone for a glass vessel, and later a similar use of *vitrum*, especially for a goblet, will be noted, all of which supports the latter interpretation.

In Hesychius (*S.*5) glass seems to be called a precious stone, but the passage is probably corrupt, for glass is also called *borboros*, 'mud,'³² an absurdity due to a confusion with *hyollos*.³³ Theognostus (*S.*9) seems to have copied the corrupt text of Hesychius and in turn to have been copied by Zonaras (*S.* 12).³⁴

A scholiast on Aristophanes' *Nubes* says that Homer did not know the word *hyalos*, but used *ēlektros* instead.³⁵ This is repeated

²⁷ Alex. Aphrod. on *de Anima*, 133, 18: εἰ δὲ λέγοιεν τὸ στερεὸν ἐπιπροσθεῖν στερεὰ καὶ ἡ ὕαλος καὶ τὸ κέρας καὶ οἱ διαφανεῖς λίθος.

²⁸ Alex. Aphrod. *Problem.* 41, 28 (Children are not hurt by a fall): τῷ λόγῳ τούτῳ καὶ σπόγγος πίπτων οὐ ῥήγνυται, ὕελος [*sic*] μέντοι ἢ ὕστρακον, ἥτι τοιοῦτον σῶμα σκληρὸν πίπτει κλᾶται.

²⁹ Rufinus (*Anth. Pal.* 5, 36).

³⁰ Grenfell-Hunt-Hogarth, *Fayūm Towns and Their Papyri* (1900), 134: Εὐδαίμ[ω]ν Λογγεῖνῳ χαίρειν. παρακληθεῖς κύριε σκύλον σεαυτὸν πρὸς ἡμᾶς φέρων εἰ δόξαν σοι τὴν ὕαλον καὶ δυνηθῶμ[εν] τὸ λογάριον περικόψε, ἐὰν . . . [*sic*], καὶ καλὸν Μαρεωτικὸν δυν[ήσε]ι μοι σειρώσαι ἐρχόμενος [τ]ῆς τιμῆς ἔρρωσσο—. Translation by the editors.

³¹ Bücheler (*Rhein. Mus.* 56 (1901), 326).

³² Hesych. ὕελος: ὕαλος <Moer.>. βόρβορος <cf. ὕολλός> ἢ λίθος τίμιος.

³³ *Ibid.* ὕολλός· τόπος συνᾶ βορβορώδης. See Hesych. ed. Schmidt, 4 (1862), 191, 18.

³⁴ Theognostus, *Canones*, 18, 28; Zonaras, *Lex.* 1759: ὕαλος ὁ βόρβορος, ἐνίοτε δὲ καὶ τὸ λαμπρόν.

³⁵ Schol. V on *Nub.* 768: "Ὅμηρος δὲ οὐκ οἶδε τὸ ὄνομα, ἀλλὰ παρ' αὐτῷ καὶ τοῖς ἀρχαίοις ἤλεκτρος μὲν ἐστίν, ὕαλος δὲ οὐ. See below, p. 178, n. 2.

by Pseudo-Philemon (*S.16*).³⁶ The Greeks designated both amber and a metallic compound of gold and silver by *ēlektron*.³⁷ Originally perhaps *ēlektros* (mas.) stood for the metal, while *ēlectros* (fem.) and *ēlektron* (neut.) stood for amber, but later these forms of the word were used indifferently.³⁸ It is uncertain whether Homer³⁹ meant amber or the metallic compound,⁴⁰ but there is very little probability that he was speaking of glass.⁴¹ However, in the time of the scholiast there may have been some connection between glass and *ēlektron*, as in the enamel described by Theophilus (*S.12*),⁴² which

³⁶ *Lex.* (ed. Osann), 171, see below, p. 36, n. 17.

³⁷ Paus. 5, 12, 7: τὸ δὲ ἤλεκτρον τοῦτο οὐ τῷ Ἀγούστῳ πεποιήνται τὴν εἰκόνα, ὅσον μὲν αὐτόματον ἐν τοῦ Ἡριδανοῦ ταῖς ψάμμοις εὐρίσκεται, σπανίζεται τὰ μάλιστα καὶ ἀνθρώπῳ τίμιον πολλῶν ἐστὶν ἕνεκα· τὸ δὲ ἄλλο ἤλεκτρον ἀναμειγμένον ἐστὶν ἀργύρῳ χρυσός. Plin. *N. H.* 33, 80: omni auro inest argentum vario pondere, aliubi decuma parte, aliubi octava . . . ubicumque quinta argenti portio est, electrum vocatur. fit et cura electrum argento addito quod si quintam portionem excessit, incudibus non resistit vetusta et electro auctoritas Homero teste, qui Menelai regiam auro, electro, argento, ebore fulgere tradit. Compare 36, 46. In Latin *electrum* was also used for the pure Latin *sucinum*, 'amber.' See *P.-W.*, 3, 1, 296. Plin. *N. H.* 37, 47: genera eius plura sunt. ex iis candida odoris praestantissimi, sed nec his nec cerinis pretium. fulvis maior auctoritas. ex iis etiamnum amplius tralucentibus, praeterquam si nimio ardore flagrent; imaginem igneam in iis esse, non ignem, placet. summa laus Falernis a vini colore dictis, molli fulgore perspicuis in quibus et decocti mellis lenitas placeat. Serv. *Comm. in Verg. Aen.* 8, 402: et secundum Plinium in naturali historia tria sunt electri genera; unum ex arboribus, quod sucinum dicitur; aliud, quod naturaliter invenitur, tertium, quod fit de tribus partibus auri et una argenti. In *Georg.* 3, 522: quod a nobis sucinum appellatur, electrum vocant Graeci. Philargyrius on *Verg. Buc.* 8, 54, version I: electra idest orarget (Irish word); version II: idest gemmae sucinae. Blümner, *Tech. u. Term.* (Bernstein), 2, 381f.; (Goldsilber) 4, 139, 166f.

³⁸ Lepsius, *op. cit.*, 138ff.

³⁹ *Od.* 4, 73 (71): φράξω, Νεστορίδῃ, τῷ ἐμῷ κεχαρισμένῃ θυμῷ | χαλκοῦ τε στεροπὴν κάδ' δώματα ἤχῃεντα, | χρυσοῦ τ' ἤλεκτρον τε καὶ ἀργύρου ἥδ' ἐλέφαντος. 15, 460 (459): ἥλυθ' ἀνὴρ πολίῳδρις ἐμοῦ πρὸς δώματα πατρός | χρύσειον ὄρμον ἔχων, μετὰ δ' ἤλέκτροισιν ἔερτο. Compare 18, 296.

⁴⁰ Helbig, *op. cit.*, 106.

⁴¹ *P.-W.* 3, 1, 295: "Rev. archéol. 16, 1859, 235 und Lagrange Recherches sur la peinture en émail dans l'antiqu., Paris 1856, Glasfluss (Smalte), Feys in der Revue de l'instruct. publ. de Belg. 1863, 461 Glas. Doch hat keine dieser Annahmen Wahrscheinlichkeit für sich, und nur darum kann es sich handeln, ob bei Homer sowie in einigen späteren Erwähnungen des ἤλεκτρον Bernstein oder die den gleichen Namen führende Goldlegierung gemeint sei." Blümner, *Tech. u. Term.* 4, 408: "Die mehrfach aufgestellte Behauptung, welche namentlich an Labarte und Cohausen Vertheidiger gefunden hat, dass das homerische ἤλεκτρον Smalte bedeute, ist zweifellos unhaltbar. Wir haben ἤλεκτρον in verschiedenen Bedeutungen kennen gelernt: als, Bernstein sowohl, wie als Silbergold; dass es daneben noch jene dritte Bedeutung gehabt habe, dafür lässt sich nirgends ein Anhalt finden."

⁴² *Sched. Divers. Art.* III, 53: de electris. hoc modo omnibus electris compositis

led him to hold this view. In Suidas (*S.10*) where the burning-glass is described, there is a confusion of glass and *êlektron*.⁴³ On the one hand, when *êlektron* stands for a metal, the lexica describe it as gold mixed with glass and stone.⁴⁴ A table in Sancta Sophia in Constantinople seems to have been made of this artificial product.⁴⁵ On the other hand, some forms of amber so closely resemble glass that they could easily be confused with it. In Hesychius *logourion*,⁴⁶

et solidatis, accipe omnia genera vitri, quod ad hoc opus aptaveris, et de singulis partibus parum fringens, colloca omnes fracturas simul super unam partem cupri, unamquamque tamen partem per se; mittens in ignem compone carbones in circuitu et desuper, sufflansque diligenter considerabis si aequaliter liquefiant; si sic, omnibus utere; si vero aliqua particula durior est, singulariter repone. accipiensque singulas probati vitri, mitte in ignem singillatim, et cum canduerit, proice in vas cupreum inque sit aqua, et statim resiliet minutatim, quod mox confringas cum rotundo malleo donec subtile fiat, sicque lavabis et ponens in concha munda, atque cooperies panno laneo. hoc modo singulos colores dispones. quo facto tolle unam partemauri solidati, et super tabulam aequalem adhaerebis cum cera in duobus locis, accipiensque pnnem anseris incisam gracile sicut ad scribendum. sed longiori rostro et non fisso, hauries cum ea unum ex coloribus vitri, qualem volueris, qui erit humidus, et cum longo cupro gracili et in summitate subtili rades a rostro pennae subtiliter et implebis quemcumque flosculum volueris, et quantum volueris. Blümner, *l. c.*: "Allerdings unterliegt es keinem Zweifel, dass *electrum* im Mittelalter die Bedeutung von Schmelz erhalten hat; bei Theophilus (*Schedula divers. art.* III. 53) wird es mehrfach in diesem Sinne gebraucht, und in lateinischen Schriften des zehnten und elften Jahrhunderts kommt es ebensowohl in dieser Bedeutung, wie in der des silberhaltige Goldes vor."

⁴³ Suid.: ὕαλη. ὕαλος. ὕαλος ἐστὶν ἀφ' ἧς πῦρ ἄπτουσι. καὶ φησιν Ἀριστοφάνης· "ὅποταν γράφοιτο ἡ δίκη, ἀπωτέρω στὰς ὧδε πρὸς τὸν ἥλιον τὰ γράμματα" ἐκτῆξαιμι τῆς ἐμῆς οἰκῆς." ἐστὶ δὲ κατασκευάσμα ὕαλου τροχοειδὲς ἢ ἡλέκτρον, εἰς τοῦτο τεχνασθὲν ὅπερ ἐλαίῳ χρίσαντες καὶ ἡλίῳ θερμήναντες προσάγουσι θρυαλλίδα καὶ ἄπτουσι. Suidas is here following very closely the scholia in R V on Aristoph. *Nub.* 768, but seems to have interpolated the word *ἡλεκτρον* which does not appear in the scholia as they are transmitted in the MSS.

⁴⁴ Cyrill (Zonaras, *Lex.* I, 106); Photius; Bachmann, *Anecd. Gr.* I, 250, 4; Suidas; *Etyim. Magn.* 425, 25; Miller, *Mélanges*, 147 (from Flor. Ms. 304); Zonaras, 986: ἡλεκτρον ἄλλότυπον χρυσίον μεμιγμένον ὑέλῳ καὶ λιθίᾳ. *Etyim. Gud.* 240, 9, has μεμυλαγμένον instead of μεμιγμένον.

⁴⁵ Suid.: ἡλεκτρον . . . οἷας ἐστὶ κατασκευῆς ἡ τῆς ἀγίας Σοφίας τράπεζα. Zonar. *Lex.* 986: ἡλεκτρον. χάλωμα καθαρὸν, ἢ ἄλλότυπον . . . τράπεζα, ὃ πανεξάιρετος τοῦ θεοῦ ναός. Salmas. *Plin. Exercit.* 761bC: "pro ἄλλότυπον etiam non dubito quin apud Hesychium legendum sit, ὕαλότυπον. sic ἄλλης λιθίας apud auctorem periplus ὕαλης λιθίας. electrum autem ὕαλότυπον. χρυσίον eleganter vocatur, quasi dicas vitreum aurum, quod auri formam habeat simul et vitri. de succino intelligendum. similiter et in hac uoce corrigendus Eudemus Rhetor: ἡλεκτρον ὕαλότυπον Χρυσίον, μεμιγμένον μετὰ ὑέλοᾷ καὶ λίθου.

⁴⁶ Hesych.: λογοῦριον ὕελος. Λάκωνες. | λογκούριον ὕαλος (λογοῦριον, Cod.). For a discussion of the spelling, see *P.-W.* 3, I, 301f.; Schmidt, *Hesych.* 3, 47, 12. In this same note there is a discussion of Hesych. ἄττυρον ὕαλον, which Schmidt

which is probably the *lynkourion*⁴⁷ mentioned elsewhere as amber, is defined as *hyalos* or *hyelos*. Perhaps the scholiast in V was thinking of an amber called *hyalos*. However that may be, the connecting of *êlektron* and glass by Hesychius, Suidas, and the scholiast in V, with the additional knowledge that glass and amber have been confused in other languages,⁴⁸ and that the term glass was in Greek occasionally applied to other transparent substances, has led several modern scholars to believe that *hyalos* might also designate amber.⁴⁹ Some would go so far as to suggest the correspondence of *hyalo-* to *sualo-*⁵⁰ which appears in *sualiternicum*, the Scythian name for amber according to Pliny.⁵¹

In a section on the goldsmith's art found in an alchemical manuscript, *hyelos* is defined as "a vitreous solder."⁵² The author of this little tract has used *hyelos* several times with this meaning.⁵³

Conclusion: Although *hyalos* usually meant glass, it was also applied to other transparent substances, such as crystal, glazes, precious stones, and amber, as has been shown. This probably arose through a confusion at a time when the precise nature of these dif-

would take as a mistake for *λίγυρον*, 'amber.' Others connect it with the Latin *vitrum*. See below, p. 61, n. 9.

⁴⁷ Hesych.: *λυγκούριον* τὸ ἤλεκτρον. "λυγιουργόν-ἤλεκτρον cod., prius Salmasius posterius Mus. correxerunt," Schmidt. On the origin of the name see Theophrastus, *de Lap.* 28; Pliny *N. H.* 37, 34.

⁴⁸ Boisacq, *op. cit.* 996. Blümner, *Tech. u. Term.* 2, 383, 1, and *P.-W.* 3, 1, 297, notes the similarity between 'glass' and the German word for amber given by Pliny in *N. H.* 37, 42: ab Germanis appellari glaesum.

⁴⁹ Sonne, *op. cit.* 12, 359; Curtius, *op. cit.* ed. 5, 395. Froehner, *La Verrerie*, 5: "Il ne serait donc pas impossible qu' on eût employé parfois le même terme pour désigner les deux matières." *Thes. Gr. Ling.* 8, 127: "Non est autem succino color unus . . . aliud fulvum et perspicuum instar vitri, quod genus Gr. nuncupant ὕαλον."

⁵⁰ Prellwitz, *op. cit.* ed. 2, 473, considers this as doubtful. However, Boisacq, *op. cit.* 996: "ὕαλο- semble répondre à l'élément sualo—'pierre transparente ou qc. de pareil' du nom scythe, c.-à-d. nord-européen de l'ambre *sualiternicum*."

⁵¹ *N. H.* 37, 33: Philemon fossile esse et in Scythia erui duobus locis, candidum atque cerei coloris quod vocaretur electrum, in alio fulvum quod appellaretur sualiternicum (hyalopyrrichum in Ulrichs, *Vind. Plin.* 2, 824, accepted by Detlefsen, ed. 1873).

⁵² Berthelot, *Collection des Anciens Alchimistes Grecs*, 335: ὁ ὕελος—τὸ βοράχον τὸ ποιοῦν μετὰ τζαπαρικὸν καὶ στύψως καὶ ἄλας.

⁵³ 5 (Berthelot, *Collection*, 323): εἰθ' οὕτως βάλε ὕελον βραχὺ εἰς ἀγγεῖον μολυβδόυν. 8 (*Idem*, 324): εἴτα θές εἰς ὕελον βοράχην παράνωθεν. ἄλλοι δὲ σαπωνίζουσι μόνον μετὰ ὕελον εἰς ψιλὴν δουλείαν. 9: καὶ μετὰ ὕελον βοράχην τὸ τρίτον. 32 (*Idem*, 329): βάλε μβουράζω ἥγουν ὕελον βραχὺ καὶ ποίησον εἴ τι θέλεις. 33 (*Idem*, 330): καὶ βάλε ἀνωθεν ὕελον θέλης ἄστρον, καὶ κόλλησον. 54 (*Idem*, 335): ἔπειτα θές αὐτὸ εἰς ὕελον μέσον τοῦ πυρὸς εἰς ἀνθρακίαν.

ferent substances was as yet not recognized, and then the erroneous usage was never entirely corrected. But it is also conceivable that even after glass had become better known, *hyalos* may have been intentionally applied to other things because of the similarity in their appearance.

3. FORM AND ORTHOGRAPHY

a. *Hyalos* (*Hyelos*). The Substantive. *Hyalos* is ordinarily feminine, presumably under Attic influence,¹ the masculine gender appearing very rarely.² With very few exceptions³ the accent comes upon the antepenult. The first vowel is short, but in late poetry it is occasionally treated as long, *metri gratia*,⁴ in some of the derivatives. Where *hyalos* designates a glass vessel, the plural number may occur.^{4a} In early alchemical formulae glass is designated by the symbol *X* or by a modification of this letter.^{4b}

The first form of the word *hyalos*, which we have preserved, at least, is *hyalinós*, used by Corinna (*S.* VI/V), as mentioned above.⁵ *Hyaloeidês* occurs in Philolaus,⁶ while *hyeloeides* in Ion of Chios⁷

¹ Schol. Pind. *Ol.* 1, 10: ἐπεὶ καὶ οἱ Ἀττικοὶ πολλὰ τῶν ὀνομάτων ἀρσενικά ὄντα θηλυκῶς ἐκφέρουσιν. Ael. Dionys. in Eustath. 1390, 50ff.: Ἀῖλιος δὲ Διονύσιος παρασημειούμενός τινα ὅπως κατὰ γένη προφέρονται, φησὶν οὕτω. κακκάβη θηλυκῶς ὁ κάκκαβος· ὁ καὶ παρὰ τῷ Ἀθηναίῳ κέϊται ἐν τῷ, κακκάβα ζέουσα. . . . καὶ ἡ ὑαλος. Photios, *s. v.* ὑαλος; Bachmann, *Anecd. Gr.* 1, 392; Schol. Aristoph. *Nub.* 768; Zonaras, *Lex.* 1759; *Etym. Magn.* 774, 3ff.; Ps.- Philemon, *Lex. Technol.* 248.

² Theophr. *de Lap.* 49: εἰ δὲ καὶ ὁ ὑελος ἐκ τῆς ὑελίτιδος ὥς τινὲς φασί. Alex. Aphrod. on Arist. *de Anima*, 142 (ed. Bruns, 1892): τοιαῦτά ἐστι τῶν διαφανῶν τὰ τε κάτοπτρα καὶ οἱ ὑελοι, where the editor emends οἱ to αἱ, perhaps without sufficient warrant. In Lucian, *Quomodo Hist. Conscr. sit*, 25, one of the MSS., Vat. 87, reads τῷ ὑάλῳ, which, however, may be a mere slip. Psellus, *Carmen de Re Medica*, 596: ὑαλος αὐτός. See below, note 3.

³ Philostratus, *Vita Ap.* 3, 1: καὶ στέγει αὐτὸ πλὴν ὑελοῦ οὐδέν. Athanasius (*Patr. Gr.* 38, 789B): ἀνατείλαντος τοῦ ἡλίου αἱ ἀκτῖνες αὐτοῦ διαπερῶσι τὸν ὑέλόν . . . ὁ ὑέλός οὐ συντρίβεται. Steph. Alex. 3, 20: καὶ ὑελῶν τῇ ἴσῃ. Alex. Aphrod. *Problem.* 1, 41, 28: τῷ λόγῳ τούτῳ καὶ σπόγγος πίπτων οὐ ῥήγγνται, ὑέλός μέντοι ἢ ὄστρακον, ἢ τι τοιοῦτον σῶμα σκληρὸν πίπτων κλᾶται. *Actus Petri cum Simone*, 30, see below, p. 158, n. 49. Orion (Sturz) and *Etym. Gud.* (Sturz), 539, 63: ὑέλός, ἐκ μεταφορᾶς τῆς ὕλης. *Chemistry of Moses*, 34 (Berthelot, *Collection*, 307): ἀφροσέληνον ὑαλοῦ, κυανός.

⁴ *Thes. Gr. Ling.* 8, 9; W. Schulze, *Quaest. Epic.* (1892), 180.

^{4a} See below, p. 156, n. 36.

^{4b} Berthelot, *Introduction*, 109: Χῦελος. (from Ms. of St. Mark's, fol. 7, fig. 4, II, 29). 114: ὑαλος X (from Ms. 2327, fig. 7, V, 17). *Hist.* 2, 4, note 5: "Le signe syriaque dérive immédiatement du signe grec." *Idem*, 2, 12.

⁵ See above, p. 23.

⁶ See below, p. 47, n. 51.

⁷ See below, p. 47, n. 52.

attests the employment of the spelling with epsilon in the fifth century B. C. Herodotus (*S. V*)⁸ is the first to use the substantive form of *hyalos*, although as we have seen, he does not apply it to actual glass. Then follows its use in Aristophanes (*S. V*),⁹ Plato (*S. V/IV*),¹⁰ and Aristotle (*S. IV*).¹¹ In the latter *hyelos* also occurs. On account of the different manuscript tradition for the separate works of Aristotle, it is impossible to tell which form Aristotle himself really used. In Theophrastus (*S. IV/III*)¹² *hyelos* appears regularly. The two forms, *hyalos*¹³ and *hyelos*,¹⁴ then continue side by side, and

⁸ 3, 24. There is some variation in spelling; *hyelos* occurs only once in manuscript P of the fourteenth century, while *hyalos* appears uniformly in the earlier manuscripts, and also in P in another instance in this same passage.

⁹ *Nub.* 768.

¹⁰ *Tim.* 61B.

¹¹ *Meteor.* 4, 10, 389A, 8: χρυσός μὲν δὴ καὶ ἄργυρος καὶ χαλκός καὶ καττίτερος καὶ μόλυβδος καὶ ὕαλος καὶ λίθοι πολλοὶ ἀνώνυμοι ὕδατος· πάντα γὰρ ταῦτα τέκεται θερμῷ. ὕελλος Brec. F corr. m. 1 HN corr. m. 1: βέλος N. *De Color.* 3, 794A, 5: ἐπὶ δὲ τῶν πυκνῶν ἐπὶ πάντων ἐπιφαίνεται τις ἀχλύς, καθάπερ ἐπὶ τοῦ ὕδατος καὶ ὕαλου (ὕελουX) καὶ τοῦ ἀέρος. *Problem.* 11, 905B, 6ff.: διὰ τοῦτο καὶ μὲν τῆς ὕελου διορᾶται πυκνῆς οὐσῆς . . . ἀλλ' ἔνια κωλύεται διὰ τὴν μικρότητα τῶν πόρων οἶον ἢ ὕελος. 25, 939A, 13ff.: ἐπαλλάττουσι γὰρ οἱ πόροι, ἀλλ' οὐκ ἐν τῇ ὕαλω. ὁ δὲ ἀήρ οὐ κωλύεται διὰ τὸ μὴ εὐθυπορεῖν οὐ διέρχεται. *Analyt. Post.* 7, 388A, 14: οἶον εἰ τὴν ὕελον τετρυπημένην ἐρωῶμεν καὶ τὸ φῶς διύνη, δῆλον ἂν ᾔην καὶ διὰ τί καίει, τῷ ὁρᾶν μὲν χωρὶς ἐφ' ἐκάστης, νοῆσαι δ' ἅμα ὅτι ἐπὶ πασῶν οὕτως. Aristotle, *Frag.* 266 (Rose (1886), p. 209, 17): ὁ ὕελος. Stob. *Ecl.* 1, 52 (Diels, *Doxogr.* (1879), 456): 'Ἀριστοτέλης ὁρᾶν ἡμᾶς κατὰ κίνησιν τοῦ κατ' ἐνέργειαν διαφανοῦς. διαφανὲς δὲ οὐ μόνον εἶναι τὸν ἀέρα, ἀλλὰ καὶ τὸ ὕδωρ καὶ τινα τῶν συνισταμένων ποθέν, οἶον ὕαλον καὶ κρύσταλλον καὶ τινας τῶν λαμπρῶν λίθων.

¹² *De Lap.* 49. *De Igne*, 73. *Frag.* 184: 'Ιχθύς ἰστορεῖ Θ. ὑπὸ ῥίγους πεπηγότας, ἂν ἀφελῶσιν ἐπὶ τὴν γῆν, κατάγνυσθαι καὶ συντρίβεσθαι δίκην ὕελων ἢ κεραμῶν σωματῶν.

¹³ Job. 28, 17; Agatharchides (Müller, *Geog. Gr. Min.* 1 (1855), 170, 6ff.; 23ff.). Strabo, 3, 1, 5, see below, p. 183, n. 26. *Ibid.* 17, 2, 3.; Antiphilos (*Anth. Pal.* 6, 250, or Suidas, s. v. νάρδος); *Anon. Lond. Iatrica* (H. Diels, Suppl. Aristot. (1893), 3a, col. 39, 18); Philo, *Leg. ad Gaium*, 45 (some of the manuscripts give ὕελος); *Peripl. Maris Erythr.* 49, 56; *Rev.* 21, 18 and 21; Ael. Dionys. in Eust. 1390, 53; Galen, 3, 760; 5, 623; 7, 138, 348; 8, 81; 11, 411, 749; 12, 185, 206; 13, 42, 663; 16, 367; Paus. 2, 27; 8, 18; Iren. (*Patr. Gr.* 5, 1388A; 7, 440); Luc. *Ver. Narrat.* 2, 14: ex ὕλου. *Idem, de Luctu*, 21; *Quomodo Hist. Conscr. sit*, 25; Alex. Aphrod. on Arist. *de Anima*, 133, 18; 138, 28; 149, 26; *Idem, Problem.* 1, 61; 2, 39; Pollux, 3, 87; 6, 14 (in MSS CV); P. Fay. 134, 4; Caesar. *Dial.* 1, 68 (*Patr. Gr.* 38, 936); Orib. 2, 711, 15, 1; 9, 550, 5 (from Galen); Orion: ὕαλη· ὕαλος. Hesych. s. v. λογούριον, ὕαλη, ὕαλος. Aen. Gaz. 552, 71; Damascius, *Dub. et Solut.* 1, 183, 11; Ach. Tat. 2, 3; Rufinus (*Anth. Pal.* 5, 36; 48); Andreas Caesar. (*Patr. Gr.* 106, 433, 437); David Armen. *Proleg. in Porphyr. Isagog.* 20, 11; Paul. Silent. *Descriptio S. Sophiae*, 409 (for the dialectic form ὕαλοιο (gen.), see *Idem*, 824 and cf. Suid. s. v. ἐνδιος and οὐρίαχος); Schol. on Plato's *Alcibiades*, 132E; Olympiodorus on Plato's *Alcibiades*, 2, 223, ὕαλοκέρας is an error for ὕαλον ἢ κέρας (see Comm. by Creuzer (1921), note 53); *Thes. Gr.*

the same is true of the compounds and derivatives. Herodian (*S.* 2)¹⁵ in his work on orthography puts *hyalos* as the preferred form, which is what would be inferred, at least, from its more frequent occurrence up to this time, and because it seems to have been the older form. Phrynichus (*S.* 2/3)¹⁶ and the later grammarians¹⁷ insist that

Ling. 8, 7; Paul Aeg. (*Corp. Med. graec.*) 6, 22, 24; 7, 3; Daremberg-Ruelle, *Oeuvres de Rufus d'Éphèse* (1879), 444, 12; Briau, *Chirurgie* (1855), 142; Theognostus, *Canon.* 18, 29; Photius, *Bibl.* 275 (*Patr. Gr.* 104, 244A); Schol. on Clem. Alex. *Paedag.* 180, 28; Psellus, *Carm. de Re Med.* 596; Zonaras, *Lex.* 1665, 1759; Nicephorus Blemm. *Epitome Log.* (*Patr. Gr.* 142, 697, 18C); Berthelot, *Collection*, 37, note 4; 307; 353, 11; 361, 34; 364, 1 (ter); 365, 3; 366, 3, 4; 378, note 7; *Introduction*, 114.

¹⁴ Hedylos in Athen. 11, 486B or *Anthol. Gr.* Append. 1, no. 115; Hero, *Pneumat.* 2, 4; *Definitiones*, 4, 102, 16; 106, 3, 10 (in the latter *ύαλος* C); Diod. 2, 15, 1, 2, 4; Joseph. *Bell. Iud.* 2, 10, 2 (*ύελον* PAML² *ύαλον* (a ex corr. V) L¹VR *ύαλλον* C); Plut. *Quaest. Conv.* 3, 19, 3; Galen. 13, 290; 16, 585; 19, 695; Mesomedes (*Anth. Pal.* 16, 323); Luc. *Amores* 26; Alex. Aphrod. on Arist. *de Anima*, 142, 28; *Met.* 588, 40. *Idem*, *Problem.* 1, 119, 120; 2, 4; Clem. Alex. *Paedag.* 2, 3, 35; 12, 118; Philostratus, *Vita Ap.* 3, 1; *Epist.* 242, 21; *P. Holm.* i, 5; Ps.-Callisthenes, 2, 18, 38; Athan. (*Patr. Gr.* 28, 789B); Apsyrus (Hippiatr. 2, 82); Orib. 5, 66, 1; Daremberg-Ruelle, *op. cit.* (1879), 569; Titus Bostrensis (*Patr. Gr.* 18, 1193C); Theodoretus (*Patr. Gr.* 83, 617A); Steph. Alex. *de Magna et Sacra Arte*, 3 (Ideler, 2, (1842), 209, 210, 213); Hesych. (see p. 29, note 32, and p. 31, note 46); Orion: *ύελός* [*sic*]; Anaphora Pilati 2 (Tischendorf, *Evang. Apoc.* 422); Philoponus on Arist. *de Anima*, 2, 6, 7; *Meteor.* A, 3, 5; Hirschberg, *Die Augenheilkunde des Aetius von Amida* (1899), 1, 25; Alex. Trall. (Daremberg-Ruelle, *op. cit.* (1879), 95); *Excerpta ex Commentariis Alexandri et Olympiodori* (Ideler, 29); Photius (see p. 31, n. 44). The spelling must be due to the copyist, for Photius says elsewhere that *hyalos* and not *hyelos* should be used); Photius *Patr. Constant.* (*Patr. Gr.* 101, 277A); Meletius (*Patr. Gr.* 64, 1168Bff.); Bachmann, *Anecd. Gr.* 1, 250, 4; Leo. Philos. *Conspect. Med.* 3, 1, 129; Suid. *s. v.* *διαφανές* and *ήλεκτρον*; *Georon.* 5, 7, 2; 9, 19, 10; Abitan. *de Urinis*, 296, 20; Scholia to Hesiod (Flach (1876), 427, 31); Psellus, *de Lap.* 1, 25; *Etym. Gud.* 78, 240; Schol. on Aristoph. *Nub.* 768; *Etym. Magn.* *s. v.* *άλάβαστρον* and *ήλεκτρον*; Zonaras, *Lex.* *s. v.* *ήλεκτρον*; Eust. on Arist. *Analyt. Post.* 151, 21ff. (*ύαλος* and *ύάλον* in MS. E); Demetrius, *Hier.* 26, 271, 281, 283; Joan. Actuarius, *de Urinis*, 2, 32, 21; 33, 12; Nemes. *de Natura Hominis* (*Patr. Gr.* 40, 645B); Berthelot, *Collection*, 25, 7; 37, 1; 38, 3; 55, 3; 75, note 20; 247, 2; 305, 27; 310, 50; 333, 43; 349, 1, 2, 3, 4; 378, 3; 389; 390; 422, note 6; *Introduction*, 108, 213. See above, p. 32, n. 53.

¹⁵ Herod. *Tech. Reliquiae* (ed. Lenz (1868), 2, 595, 15: *ύαλος ύελος*.

¹⁶ De Borries, *Phryn. Praepar. Soph.* (1911), 118: *ύάλινα και ύαλος*: *διά τοῦ α̃, οὐ διά τοῦ ε̃*. Lobeck, *Phryn.* (1820), 309: *ψίεφος, μιερός, ύελος, άμαρτάνουσιν οἱ διά τοῦ ε̃ λέγοντες. άδόκιμον γάρ. και Κορίννα τὸν ύάλινον παῖδα θήσεις. 'Ο πύελος διά τοῦ ε̃, και μυελός ρήτέον*. "Primum articulum Edd. Pr. V et Phav. omittunt Secundum articulum Ed. Pr. hoc modo scriptum exhibet: *πύελος, μυελός, ύελος ρήτέον. άμαρτάνουσι γάρ οἱ μὴ διά τοῦ ε̃ λέγοντες, αλλά διά τοῦ α̃*. In oculis incurrit, haec non ab eodem Phrynicho scribi potuisse . . . ύαλος non ύελος dicendum esse, uno ore tradunt Phrynichus App. p. 68. Dionysius Atticista, Photius, alii. v. Sallier p. 373. Neque Theophrasti auctoritas, quam ille praetexit, tanta videri debet, ut grammaticorum sententiae, Aristophanis et Platonis testamentis

the spelling with alpha is the only correct one, while a certain Polybius, of whom practically nothing is known, even lists *hyelos* as a barbarism,¹⁸ which is surely going too far. The grammarians no doubt merely mean that *hyalos* is the Attic form and *hyelos*, the Hellenistic, as, indeed, it is once expressed by Moeris¹⁹ and Thomas Magister (*S.* 13/14).²⁰ This is only partly true, for although *hyalos* is Attic, it is also Boeotian²¹ and Ionic.²² It is, therefore, probably just the older form. There are a few other words which have similar

communitae, idcirco abrogemus." Rutherford, *The New Phryn.* (1881), 281: ψίεθος . . . θήσεις. "This article is not found in any of the manuscripts, in the editions of Calligeres or Vascosan, or in Phavorinus; but the first Laurentian manuscript and the first editor include ὕελος in the next article. Much of this part of the book is undeniably spurious." See also Schöll (*Sitzungsber. der Münch. Akad.* 2 (1893), 500).

¹⁷ Photius: ὕαλος· διὰ τοῦ α· οὐχὶ ὕελος· καὶ θηλυκῶς ἢ ὕαλος· καὶ ὑάλινον· Ἀριστοφάνης Ἀχαρνέσιν· ἐξ ὑάλινων ποτηρίων καὶ χρυσίδων· πάντα δὲ τὰ τοιαῦτα διὰ τοῦ α λέγονται. Bachmann, *Anecd. Gr.* 1 (1828), 392ff. (the same as Photius through χρυσίδων). Bekker, *Anecd. Gr.* 1 (1814), 68, 22: ὑάλινα καὶ ὕαλος· διὰ τοῦ α, οὐ διὰ τοῦ ε. Schol. on Aristoph. *Nub.* 768 (Dübner (1855), 116): ὅτι δὲ ὕαλος θηλυκῶς, καὶ διὰ τοῦ α. Zonaras, *Lex.* 1759: καὶ τὴν ὕαλον θηλυκῶς ἐν τῷ ἄλφα λεκτέον, οὐχὶ ἐν τῷ ε. *Etym. Magn.* 774, 3ff.: ὕαλος· διὰ τοῦ α, οὐχ ὕελος· καὶ θηλυκῶς, ἢ ὕαλος. Miller, *Mélanges de Lit. Grec. Etym. Mag.* (1868), (Flor. MS. 304) 290: ὕαλος, 774, 4: καὶ ὑάλινον· Ἀριστοφάνης ἐν Ἀχαρνέσιν (v. 74 ubi ἐκ πωμάτων καὶ χρυσίδων): ἐξ ὑάλινων ποτηρίων καὶ χρυσίνων. πάντα δὲ διὰ τοῦ α λέγεται. Ps.-Philemon, *Lex.* 171 (a forgery, probably written by J. Diassarinus, according to Krumbacher, *Gesch. d. byzant. Lit.* ed. 2 (1897)): ὕαλος· παρ' Ἀττικοῖς, ὃ ὕελος· καὶ ὑάλοεν, διαφανές. Ἀριστοφάνην· τὴν ὕαλον λέγεις. ὅπερ κατασκευασμὰ ἐστὶν ὑάλου τροχοειδὲς παχύ, ἐφ' οὗ χέοντες ἔλαιον, καὶ χρίοντες αὐτό, καὶ θερμαίνοντες, προσάγουσι θρυαλλίδα· καὶ οὕτως ἄπτουσιν. ὅτι δὲ ὕαλος θηλυκῶς καὶ διὰ τοῦ α, φανερόν παρ' Ἀττικοῖς· Ὅμηρος δὲ τὸ ὄνομα οὐκ εἶπεν, ἀλλὰ παρ' αὐτῷ καὶ τοῖς ἀρχαίοις ἡλεκτρός ἐστὶν, ὕαλος δὲ οὐ. Note 248: "Similia Phavorinus h. v. p. 1789. 1."

¹⁸ *De Barbarismo et Soloecismo* (Nauck, *Lex. Vindob.* (1867), 284): περὶ δ' ἐναλλαγὴν γίνεταί βαρβαρισμός. περὶ τὰς προσωδίας, καὶ ὅταν ἕτερα ἀνθ' ἑτέρων λαμβάνηται γράμματα οἷον εἴ τις λέγοι φιέλην τὴν φιάλην καὶ ὕελον τὴν ὕαλον. The MS. here (see Boissonade, *Anecd. Gr.* 3 (1831), 230) gives: φιέ φιάλην καὶ ὕελον τὴν ὕα ἀτε. All that can be said of the date of Polybius is that his work appears in a manuscript dated 1496. See Boissonade, 229.

¹⁹ *Attic. Lex.* 275: ὕαλος, ἐν τῷ α, Ἀττικῶς. ἐν τῷ ε, Ἑλληνικῶς. Sallier (1831) on Moeris, 275: "Ita Lucianus, qui ut et Theophrastus, ὕελος t. I. p. 1044. scribere non dubitavit. τὸ δ' ἄλλο σῶμα, inquit, μηδ' ἀκαρῇ τριχὸς αὐταῖς ὑποφουομένης ἡλέκτρον φασίν, ἢ Σιδωνίας ὕελου διαφεγγέστερον ἀπαστράπτει. Quod si ὕαλος etiam in eiusdem scriptis occurrit, ex eo illud tantum sequitur, nomen ὕαλος et ὕελος nullo discrimine ab Atticis usurpatum." *Thes. Gr. Ling.* 8, 9.

²⁰ 365, 1ff.: ὕαλος Ἀττικοί. Ἀριστοφάνης ἐν νεφέλαις· τὴν ὕαλον λέγεις. ὕελος δὲ ἀπλῶς Ἑλληνες. See G. Meyer, *Gr. Gram.* ed. 3 (1896), 159; Blass, *Gram. d. N. Test.* (1902), 21.

²¹ See Corinna in *Phryn.* 309.

²² See Herodotus, 3, 24.

alternate forms, the origin of the second one of which is often unknown.²³ It has been suggested that *hyelos* is produced by a weakening of the alpha,²⁴ or that it is an Ionic form²⁵ admitted by late Atticists.²⁶ *Hyalos* also survived in popular speech along with *hyelos*, as is shown by its use in literature which made no pretense to Atticism, such as the New Testament,²⁷ its appearance in papyri,²⁸ and its survival in modern Greek.²⁹

b. *Hyalos* (*Hyelos*). The Adjective. *Hyalos*³⁰ (*hyelos*)³¹ sometimes occurs as an adjective of three terminations. The *Etymologicum Magnum* (S. 12) gives *hyalinus* as preferable to *hyalos*,³² and this statement is, of course, correct if one judges by standards of frequency of occurrence. It has been suggested that *hyalos* here may be an error for *hyalous*,³³ but, despite the fact that other lexica in much the same connection speak of *hyalous*, there is no doubt that *hyalos* was also used as an adjective, and such a correction here would be nothing less than the destruction of evidence. Finally it should be noted that among the Romans *hyalos* was also glossed by

²³ Brugmann, *Grundriss*, 2 (1870), 174; Schweizer, *Gram. der pergamen. Inschr.* (1898), 36.

²⁴ Schmid, *Der Atticismus*, 4 (1896), 683.

²⁵ Smyth, *The Greek Dialects* (1894), 140: "Forms in -ελος in the κοινή were once held to be Ionic, perhaps because of Hom. πύελος μυελός, later πύαλος μυαλός." Thumb, *D. gr. Sprach. im Zeitalter des Hellenismus*, ed. 2 (1901), 75; Solmsen, *Handb. der griech. Laut. u. Formenlehre* (1903), 178; Blass-Debrunner, *Gram. d. N. Test.* ed. 4 (1913), 29.

²⁶ Schmid, *op. cit.* 4, 580: "Vulgarismen . . . welche aber möglicherweise als Ionismen passierten."

²⁷ Kühner-Blass, *Gr. Gram.* 1, ed. 3 (1890), 117; Schweizer, *op. cit.* 36; Thumb, *op. cit.* ed. 2, 18, 76.

²⁸ See above, p. 29, n. 30; below, n. 30.

²⁹ Dieterich, *Untersuch. z. Gesch. d. Gr. Spr.* (1891), 69; Kyriakides, *Mod. Gr.-Eng. Dict.* ed. 2 (1892), 784ff., 787; Koumanoudes, *Synag. Neon Lex.* 2 (1900), 1021ff., 1030. On the development of *yali* see Jannaris, *An Hist. Gr. Gram.* (1897), 151; Chatzidakis, *Gloss. Melet.* 1 (1901), 222; Cousin, *Études de Géog. anc.* (1906), 254.

³⁰ P. Ox. 13, 10, 1294, 6: ὑάλαι λάγυνοι δ' ὕγεια; cf. Luc. *Quomodo Hist. Conscr.* sit, 25, where, according to Sommerbrodt (1893), the following variants occur: ὑάλα Marc, 434, Vatic. 90. ὑαλᾶ Harl. ὑαλλᾶ Vatic. 87," which, although incorrect readings for Lucian, do yet, when combined with other evidence, attest the existence of these as possible forms.

³¹ Galen, 14, 409; Ps.-Callisthenes, 2, 38, 7; Paul. Aeg. (ed. Ald.) 35, 10; Zosimus (Berthelot, *Collection*, 236, note 15: ὑέλους M K).

³² 774, 3: καὶ ὑάλινον, ἀντὶ τοῦ ὑαλον. Cf. Miller, *Mélanges*, 290: ὅθεν καὶ ὑάλινα ἀντὶ τοῦ ἄλα (ὑαλα?).

³³ "Pro ὑαλον sententia requirit potius ὑαλοῦν, vitrium," wrote Sylberg, unaware apparently of this employment of ὑαλος-η-ον as an adjective.

vitreus,³⁴ although this might be the noun *hyalos* glossed by the substantive *vitreum*. In every case the significance is 'made of glass,' but Hesychius³⁵ also gives the derived meaning 'bright.'

c. *Hyallos* (*Hyellos*). In late Greek a spelling with the double lambda, i. e. *hyallos* and *hyellos*, sometimes appears.³⁶ It is impossible to say at just what time this spelling begins, but the manuscripts in which these forms occur (in so far as I could find any indication of their age) range from the eleventh to the fourteenth century, and the double *l* is used in some of the Aldine editions also (see preceding note), so that this must have been a vulgar spelling which had grown pretty common by the fifteenth century, but is not attested by papyri or inscriptions, and hence is probably Byzantine in origin.

d. *Hyalê*. Like a few other nouns (e. g., *chônos-nê*, *tylos-lê*, etc.),^{36a} the word for glass, according to the lexicographers,³⁷ was also

³⁴ *Corp. Gloss. Lat.*: vitr[e]um vitreus ὕαλος; vitreum ὕελος.

³⁵ *S. v.* ὑαλόν· λαμπρόν. Schmidt: "In cod. ὑαλόν scriptam, malui in ὑαλοῦν mutare, quam cum Thes. in ὑαλόεν." See *Thes. Gr. Ling.* 8, 7, *s. v.* ὑαλός. There seems to be no need for changing the manuscript reading.

³⁶ Herodotus, 3, 24: ἐξ ὑάλλον v¹ (*S.* 14); Arist. *Meteor.* 4, 10, 389A, 8: "ὕελλος B rec. F corr. m. 1." (*B. S.* 12, *F. S.* 14); Strabo, 17, 2, 3: ὕαλλον *F*(*S.* 14); Joseph. *Bell. Iud.* 2, 10, 2: ὕαλλον *C*(*S.* 11); Herodian, *Epim.* 138: ὕελλος· ὑέλλοψός (note: "ὕελλος quod sequitur sic per duplex λ scriptum est in *Lexico π. πνευμ.* p. 236," Boissonade); Luc. *Ver. Hist.* 2, 11: ὑέλλινοι *Vatic.* 87 (Sommerbrodt), *N*(Nils Nilén); *Idem*, *Quomodo Hist. Conscr. sit*, 25: ὕαλλα, ὑάλλου *Vatic.* 87; Alex. Aphrod. on Arist. *Met.* 588, 40: ὑέλλον *AL*(*S.* 13); Ps.-Callisthenes, 2, 38 (ed. Meusel, n. 42): ὑέλλινω (quoted in Crönert, *Memoria Gr. Herculanensis*, 75, 7); Hesych. *s. v.* αἰττυρον *Ald.* (1514): ὕαλλον; *Idem*: ἔνβενος· ὑελ[λ]οειδής. [ἐνβεννοειδής· ὑέλλοῦδης (*sic*) *C*]; *Idem*: κρόσταλλος εἶδος ὑέλ[λ]ου (Schmidt: "Dialectus est Cypria. ὑέλλου cod., em. Palmer"); Alex. Aphrod. *Problem.* 1, 132 (ed. Ideler (1841), 1, 45): διὰ τί τὰ ὑέλινα κάτοπτρα λάμπουσιν ἄγαν, ὃ τι ἐνδοθεν αὐτῶν χρίουσι κασισιτέρω πέφευκε δ' αὐτοῦ ἡ φύσις διανγῆς καὶ τῇ ὑέλλω ἀναμειγνυμένη λαμπρῇ οὕσῃ πλέον διαναγάζεται, καὶ τὰς ἰδίας ἀκτῖνας διὰ τῶν πόρων τῆς ὑέλλου παραπέμπουσα διπλασιάζει τὸ ἐπὶ πολλῆς καὶ ἐκτὸς τοῦ σώματος τῆς ὑέλλου καὶ οὕτως γίνεται σφόδρα λάμπουσα. Olympiod. on Arist. *Meteor.* 4 (ed. Ideler, 2 (1836), 228); *Ald.* ὑελλέψαις (Ideler quotes Hesych. ὑελλέψαις· ὑελοτέρχαι, but there is no indication in the Schmidt edition of a double lambda in this passage); J. Nicole, *Le livre du préfet* (1893), 71 (*Cod. Jul. Asc.*), 19, Title: περὶ ὑελλουργῶν καὶ τῶν ὁμοίων. I. 1. ὑελλουργούς. Gen. MS. 23 Σ (*S.* 14); Suid. *s. v.* ἡλεκτρον. MS. E ὑέλλω; Zonaras, 1043: ὑέλλινον. 1665: ὑέλλος A; Georg. Lacapen. *de Syntaxi*, 114: ὥσπερ γὰρ ὁ ἥλιος διὰ μέσου ὑέλλου, ἡ ὕδατος τὰς ἀκτῖνας ἐκπέμπει τὸ φῶς (quoted from DuCange).

^{36a} Lobeck, *Pathol. Proleg.* 7ff.

³⁷ Orion (Sturz); Photius; Bachmann, *Anecd. Gr.* 1, 393; Suidas; *Etym. Gud.* (Sturz), 538): ὑάλη· ὕαλος. Hesych. also defines *hyalê* as *hyalos*, but he gives it the further meaning of a 'worm.' ὑάλη· ὕαλος· βόμβυξ. σκόληξ. Similarly, ὑάλεται· σκωληκιᾷ. Elsewhere εὐλή is defined as a worm: εὐλάζει· καπρᾷ. σκωληκιᾷ. | εὐλαί·

heteroclitic, i. e., *hyalos* and *hyalê*. The latter form, however, occurs very seldom outside the lexica. In two manuscripts of Suidas, where he is quoting Antiphilus, *hyalês* is used instead of *hyalou*.³⁸ An interpolation in the text of Dioscorides³⁹ contains the word *hyalê*, but the accent falls upon the last syllable, a thing which happens very rarely with *hyalos* (*hyelos*). It is possible that the *hyalê* (oxytone) of the Interpolator is not just the same as the *hyalê* (paroxytone) which the lexica define as 'glass,' but some special kind of a glass vessel. Yet those who define it as a 'vial'⁴⁰ or 'glass vessel'⁴¹ do not explain its accent, but consider it the same as the *hyalê* with the ordinary accent, i. e., paroxytone. In that case there is no reason to give it any further definition than that of the lexica, simply 'glass.' The Greeks used *hyalos* (*hyelos*) for a glass vessel or something made of glass. The physicians especially speak of putting a medicine 'in' or 'into a glass' without any specification as to the nature of the vessel. The use of *hyalê* (oxytone) by the Interpolator of Dioscorides seems very similar. Of course this may have been a vial, and so might the hard-glass of Antiphilus, but since the word vial is not derived from *hyalê*, and there is nothing in the context to throw light upon the shape of the vessel, except that it is likely to have been of small or moderate size, any opinion is nothing more than a guess. Then in spite of the oxytone accent which occurs so seldom in *hyalos*, it seems probable that *hyalê* (oxytone) is the same as the *hyalê* (paroxytone) defined as *hyalos* in the lexica, and, when used

οἱ ἐν τοῖς τραύμασι γινόμενοι σκώληκες. | εὐλᾶς· σκώληκας. | εὐλέων· σκωλήκων.
From this it has been conjectured that ὑάλη and ὑάλεται are probably dialectic forms for εὐλή and εὐλάζει. *Thes. Gr. Ling.* 8, 7, s. v. ὑάλομαι: "Fortasse alicubi ὑάλεται pro εὐλάται et ὑάλη pro εὐλή corrupte scriptum reperit. Supra εὐλάζει· σκωληκιῇ. Ruhnke." See Curtius, *op. cit.* ed. 5 (1879), 564: "While the stem εὐλα with prefixed ἐ stands for ἐ-φλα in ὑαλα the initial φ survives in the form of υ, . . . ὑάλεται, however, is no denominative like σκωληκιᾶν· εὐλάζειν, . . . but must be regarded as a primitive verb in the sense of 'swarms'."

³⁸ Suid. s. v. νάρδος· μυρέμικον ἔλαιον. θηλυκῶς. καὶ ἐς κυανότριχα χαίτην νάρδον, ὑπὸ γλαυκῆς κλειομένην ὑάλον (ὑάλης reading of MSS. B. E.).

³⁹ Interpolator of Diosc. 1, *Parabil.* 170 (ed. of Venice 1518): βαλὼν αὐτὸ εἰς ὑάλην, καὶ κρέμασον εἰς ἥλιον ἡμέρας λ'. These interpolations date from the period between Galen and Oribasius (Wellmann in *P.-W.* 5, 1141, 9ff.).

⁴⁰ Du Cange, *Gloss. Med. et Inf. Gr.* 2: ὑάλη "vas vitreum colli angustioris, nostris inde Fiole," quoting the interpolator of Dioscorides, 1, *Parabil.* 170. Since, however, *fiole* is derived from L. *phiala*, Gr. φιάλη (see Skeat, *An Etym. Dict. of the Eng. Lang.* (1910), 690), this view is clearly wrong.

⁴¹ *Thes. Gr. Ling.* 8, 9, on *Peripl. Maris Erythr.* λιθίας ὑάλης πλείονα γένη: "Interpr. Omnis generis vasa vitrea," but this is clearly the adjective and not a noun, and hence does not belong here.

alone for a glass object, it is to be interpreted according to the context.

e. *Proper Nouns*. Among the nymphs of Diana there was one by the name of *Hyalê*, the 'Glassy-bright,' a designation which probably suggests the bright, clear water of mountain springs.⁴²

In a list of Athenian Ephebi, as given by Boeckh,⁴³ the name *Loukios Hyalos* occurs. Keil⁴⁴ thought this very doubtful, and proposed *Hyllos* but there is no doubt of the reading of the inscription,⁴⁵ and in view of *Hyalê* (above) the name seems to be a possible one.⁴⁶

According to Nicolaus Damascenus (*S. I*), ^{46a} "Among the Lybian Hyaloi a man rules over the men while a woman rules over the women." This is probably only an accidental homonym.

f. *Hyalas*. The form *hyalas* occurs in a Greek papyrus in the British Museum.⁴⁷ Kenyon regards the termination as irregular, and lists it in the index under *hyalos*. It is very unlikely, however, that this has anything to do with glass, but by folk etymology it probably arises from *gyalas*,⁴⁸ a special kind of cup mentioned by Athenaeus.⁴⁹

g. *Aityron*. In Hesychius (*S. 5*) *aityron* is defined as *hyalon*. There have been repeated efforts to connect it with the Latin *vitrum*,

⁴² Ovid. *Metam.* 3, 171: excipiunt laticem Nephelæque Hyalæque Rhanisque | et Psecas et Phiale funduntque capacibus urnis. Of course *Hyelê*, the old name for Elea (Strabo, 6, 1, 1; Herod. *Tech. Reliquiae*, 1, 284, 23; Diog. Laert. 9, 28), a town in Lucania, has nothing to do with *hyalos*. It represents the Latin *Velia*, the upsilon standing for the Latin *V* or *W* sound (Schulze in *Kuhns Zeitschr.* 33 (1895), 396; Kretschmer in *Wiener Eranos* (1909), 120).

⁴³ *CIG*, 1, 286: ΛΟΥΚΙΟΣ ΤΑΛΟΣ = IG III, 2, 1161, 21.

⁴⁴ *Spec. Onom. Gr.* (1840), 77.

⁴⁵ *Hyelos* (Pape-Benseler, *s. v.* "Ἰελος) does occur as an error for *Euryalê*, the mother of Orion. See Schneider, *Nicandrea Theriaca et Alexipharmaca*, 5, 26: 'Ἡσιόδος δὲ φησιν αὐτὸν ἐξ Εὐρύαλης τῆς Μίνως θυγατρὸς εἶναι καὶ Προσεδῶνος. Note on 'Ἡσιόδος' ["cf. schol. Arat. phaen. 322 Eratosthenes catast. 32 Εὐρύαλης Eratosthenes l. c. Apollod. 1, 4, 3 ἑλίου KA.]"

⁴⁶ It is in the Louvre, no. 140 in Froehner's *Inscr. gr. du Musée du Louvre*.

^{46a} Frag. (*Hist. Gr. Min.* 1 (1870), 149): ἐν Τάλοις Λίβυσιν ἀνὴρ μὲν ἀνδρῶν βασιλεύει, γυνή δὲ γυναικῶν.

⁴⁷ *P. Lond.* 2 (1898), 402, 13: ποτηριον ναλας (*sic*).

⁴⁸ Wilcken (*Archiv für Papyrusf.* 1 (1901), 135); Herwerden, *Lex. Gr. Supp. et Dialect.* (1904), *s. v.* ὑάλας; Mayser, *Gram. d. gr. Pap.* (1906), 164.

⁴⁹ 11, 31: ΓΥΑΛΑΣ. Φιλητᾶς ἐν Ἀτάκτοις Μεγαρέας οὕτω φησὶ καλεῖν τὰ ποτήρια, γυάλας. Παρθένιος δ' ὁ τοῦ Διονυσίου ἐν πρώτῳ περὶ τῶν παρὰ τοῖς ἱστορικοῖς λέξεων ζητουμένων φησὶ: Ὑάλας ποτηρίου εἶδος, ὡς Μαρσύας γράφει ὁ ἱερεὺς τοῦ Ἡρακλέους οὕτως ὅταν εἰσὶν ὁ βασιλεὺς εἰς τὴν πόλιν, συναντᾶν οἶνον πλήρη γυάλαν ἔχοντά τινα, τὸν δὲ λαβόντα σπένδειν'.

especially as a Grecizing of *vitrum*,⁵⁰ but it seems much better to connect ΑΙΤΤΡΟΝ and ΛΙΤΤΡΟΝ as is done by Schmidt.⁵¹

4. SIMPLE DERIVATIVES

a. **Hoialas*. A curious form *hoiala* occurs among the Christian sepulchral inscriptions. It has been plausibly interpreted as a vulgar variant for *hyala*, that is, the genitive singular of **hyalas*, to indicate a worker in glass.¹

b. *Hyaleis*. See below, notes 2 and 8a.

c. *Hyaleos* (*Hyeleos*). Neither *hyaleos*² (*hyeleos*)^{2a} nor the contracted form, *hyalous*³ (*hyelous*),⁴ occurs before the time of Strabo. The uncontracted form is rare, but the use of *hyalous* is fairly common, although not so common as that of *hyalinos*, for which the grammarians⁵ express a preference above other adjectives of a similar meaning. *Hyaleos* usually has the significance 'of glass,' 'made of glass,' but sometimes it also means 'bright,' 'smooth,' 'transparent,' or 'like glass.'⁶ It is used in describing the cheek of a boy,⁷ and eyes.⁸

⁵⁰ See below, p. 61, n. 9-10; p. 62, n. 20; p. 63, n. 8.

⁵¹ See above, p. 31, n. 46; *Zeitschrift. f. vergl. Spr.* 9 (1860), 399ff.

¹ Bayet (*Bull. de Corr. Hellén.* 2 (1878), 166, n. 62); IG 3, 3436: Κυμητ[ή]ριον Εὐφρασείου οἰαλᾶ κε Γενναδίας.

² Strato (*Anth. Pal.* 12, 249); Maecius (*Anth. Pal.* 6, 33), of uncertain date, as well as the following. Wessely, *Corp. Papyr. Hermopolitan.* (*Stud. zur Pal. u. Papyruskunde*, 5 (1905), 9, 6): καὶ σκεύη ποικίλα ὑέ[λεα]. Hesych.: ὑάλε(ο)ν. "ad h. l. ὑάλέν non erat ὑάλεον corrigendum cum *Thes.*, sed ὑάλεον (hoc accentu, Lob. *Path. Prol.* 101) quod ordo poscit," Schmidt.

^{2a} Zosimus, 14 (Berthelot, *Collection*, 234); βίκος ὑέλεος.

³ Strabo, 4, 5, 3; Damocrat. in Galen, 14, 99, 5; *Peripl. Maris Erythr.* 6, 7, 17, 39; Dio Cassius, 57, 21, 7; Luc. *Quomodo Hist. Conscr. sit*, 25: ὑάλινα (ὑάλα ΩΓ ὑαλᾶ Harl., Sommerbrodt). Hippolytus, *Elenchos*, 4, 235, 2; Hesych. *s. v.* τριόπιος et ὑαλοῦν. Zosimus, 6 (Berthelot, *Collection*, 183); Paul Aeg. 7, 14, 1.

⁴ *P. Lond.* 2, 191; Soranus (Ideler, 1 (1841), 248); Galen, 13, 41; 54; 97; 98; 1056; 1057; Hippolochus in Athen. 4, 129D; Clem. Alex. *Paedag.* 2, 4, 39; *P. Fay.* 104, 1, 2; Pollux, 6, 14 (ὑάλου CV, ὑελοῦν CA); Orib. 1, 384; 2, 60 (from Antyllus), 62, 64; 4, 630; Paul. Aeg. 3, 2, 6; 7, 8, 6; 7, 20, 11 and 33; *Geopon.* 9, 19, 9; Wessely, *Pap. der Bibliothèque nat. f. 9 verso* (*Denkschr. d. kaiserl. Akad. d. Wissenschaften*, 36 (1888), 758); Leemans, *Pap. Gr. Mus. Ant. Publ.* Lugduni-Batavi, 2 (1885), 10, 16, 27; Berthelot, *Collection*, 75, 12 (quater); 141, 1; 236; 313, 59; 420, 11; 422, 3, note 6.

⁵ Photius (Porson): ὑάλινα· ἀντὶ τοῦ ὑαλᾶ. "Accent. om. m. pr. ὑάλα voluit corrector, ni fallor." Zonar. 1759: ὑάλινον, οὐχι ὑαλον. See note 8.

⁶ Hesych.: ὑάλε(ο)ν· λαμπρόν, ὑαλίζον. See *Thes. s. v.* ὑαλόεις. Hesych.: ὑαλο(ῶ)ν· λαμπρόν· πρᾶον. See above, p. 38, n. 35. πρᾶον seems to be misplaced, as it makes no sense here. I should retain the manuscript reading.

⁷ Strato (*Anth. Pal.* 12, 249): βουποιήτε μέλισσα, πόθεν μέλι τοῦμόν ἰδοῦσα | παιδὸς ἐφ' ὑάλεην ὄψιν ὑπερπέτασαι. Paton translates this "smooth as glass."

There is no indication that *Hyalea*, *Hyaleis*,^{8a} the later name of the town of Daldis, had any connection with glass, yet one cannot but wonder whether *Hyalea* and *Hyelion*,⁹ a place in the neighborhood of Daldis, were not derived from *hyalos* because of some local characteristic which suggested glass, or because glass was manufactured in their vicinity.

d. [*Hyalês*]. See below, note 16.

e. [*Hyalieus*]. See below, note 15.

f. *Hyalizô* (*Hyelizô*). The present participle of *hyalizein*, 'to be like glass,' is employed to describe resin,^{9a} gums,¹⁰ the slag of lead,¹¹ natron^{11a}, and gems.¹² Hesychius uses it in defining *hyale(o)n*.¹³ The resin is said to be 'like glass in color.' This raises the question what 'glass-colored' means.¹⁴ Resin is a clear yellowish substance. The only characteristic which glass and resin have in common is transparency, which although not technically a color, seems to be the meaning of 'like glass in color' in this instance, at least.

g. [*Hyaliês*]. *Hyaliês* occurs in Hesychius¹⁵ in a corrupt passage, which is copied by later lexicographers.¹⁶ Since *hyaneos*¹⁷ is de-

Since transparency is the chief characteristic of glass, when a complexion is said to be like glass, the suggestion is of a fair, clear complexion.

⁸ Hesych. s. v. τριπίς: τριόφθαλμος. ἐνιοι ζῶν ὅμοιον ἀκρίδι. καὶ περιτραχήλιον τρεῖς ἔχον ὀφθαλμούς ὑαλοῦς. "Denique ὑαλοῦς cod., ὑαλου Salmas., ὑαλίνους Sopingus, em. Lob. *Phrynich.* 309."

^{8a} Tomaschek, *Sitzungsb. Akad. Wien*, 124 (1891), 98; "Nahe lag wohl auch Δάλδεis, das spätere Τάλεα, Ταλεῖς (vgl. Τέλιον nahe der Mäanderbrücke, Nicet. Chon. VI, 7, a. 1176?)." Büchner, *P.-W. s. v. Hyalea, Daldis*.—According to the latter: "Daldis oder Daldeia . . . , Stadt in Maionien an den Grenzen von Mysien, Lydien und Phrygien, meist zu Lydien gerechnet Spätere Namen: Kaisareia, dann Flavia oder Flavia Kaisareia und Flaviopolis."

⁹ *Idem.* s. v. *Hyelion*: "Hyelion Τέλιον Ort nahe an der Maianderbrücke bei Daldis." See below, n. 42.

^{9a} Dioscorides, I, 91 (*de Terebintho*): ἡ δὲ καὶ διαφέρει διαναγεστέρα οὔσα, λευκή, ὑαλίζουσα τῷ χρώματι καὶ κυανίζουσα, εὐώδης, τερμίνθου πνέουσα.

¹⁰ *Ibid.* I, 133 (*de Acacia*): τὸ δὲ κόμμι τῆς ἀκάνθης διαφέρει τὸ σκωληκοειδές, ὑελίζον, διαυγές, ἄξυλον εἶτα τὸ λευκόν. Compare Orib. 5, 72, 10.

¹¹ Dioscorides, 5, 97 (*de Scoria Plumbi*): σκωρία μολύβδου ἀρίστη ἐστίν ἡ ψιμυθοφανής, πυκνὰ καὶ δύσθραυστος, μηδὲν ἔχουσα μολυβδῶδες, μηλινοειδὲς τῷ χρώματι καὶ ὑελίζουσα.

^{11a} *Chemistry of Moses*, 62 (Berthelot, *Collection*, 314): ἐλινικόκκιον νίτρον ὑαλίζοντος οὐγγ. δ'. *Idem.*, 63: καὶ νίτρον ἀγρικόν ὑαλίζον μέρος α'.

¹² Psellus, *de Lap.* I, 2: ὁ ἄδαμας· χροῖαν μὲν οὗτος ἔχει ὑελίζουσαν καὶ στιλπνήν.

¹³ See note 6, page 51.

¹⁴ See below, page 51.

¹⁵ *S. v.* ὑαλῆς ἢ ὑαλιεύς· εἰκαῖος· βλοσυρός.

¹⁶ Theognostos, *Canones*, 18, 29: ὑαλίνης εἰκαῖος, βλοσυρός. Cf. Zonar. 1759: ὑαλῆς· εἰκαῖος· βλοσυρός.

finned exactly as *hyaliês*, doubtless the ΔΙ of the latter is a mistake for Ν, as suggested by Schmidt.¹⁸

h. [*Hyalikos*]. See below, note 31.

i. *Hyalinos* (*Hyelinos*). The adjectival form *hyalinos* occurs in literature before *hyalos*. In supporting his preference for *a* rather than *e* in the word *hyalos* Phrynichus (*S.* 2/3)¹⁹ mentions the use of *hyalinos* by Corinna (*S.* VI-V). This passage is extremely obscure, however, and although attempts to emend the word are certainly not justified, nothing can be learned about glass from the expression which is quoted. Aristophanes (*S.* V)²⁰ is the first to speak of a vessel made of glass, and it is partly on his use of *hyalinos* that later grammarians base their preference for the spelling with *a*.²¹

*Hyalinos*²² was used over three centuries before *hyelinos*, which does not occur until the second century before Christ, more than a hundred years after *hyelos*. But from then on *hyalinos*²³ and *hyelinos*²⁴

¹⁷ Hesych. *s. v.* ὑανέος· εἰκαῖος. βλοσυρός.

¹⁸ Hesych. (ed. Schmidt), note on ὑαλῆς. See Curtius, *op. cit.* ed. 5, 565.

¹⁹ See note 16, page 35. There have been numerous conjectures concerning this passage, for which see Lobeck on Phryn. 309, note a; Rutherford, *op. cit.* 281; Bergk, *Poet. Lyr. Gr.* 3 (1882), frag. 42. Once in a while *hyalinos* does mean 'glass-like,' and since skin is sometimes compared with glass because of its brightness, smoothness, or transparency, it is possible that ὑάλινον παῖδα means a child with a clear, smooth complexion. See note 7 above.

²⁰ *Ach.* 74: ἐξ ὑάλινων ἐκπωμάτων. Quoted in Pollux, 6, 100: Ἀριστοφάνης δὲ που ἔφη Ἐπίνομεν ἐξ ὑάλινων ἐκπωμάτων. 10, 68: ἐν δὲ Ἀχαρνέυσιν Ἀριστοφάνης ἐξ ὑάλινων ἐκπωμάτων καὶ χρυσίδων.

²¹ See notes 16 and 17, pages 35f.

²² IG 2, 646, 4: ὑάλινον[ν ἄ] ργυροῦν, σταθμ[ὸ]ν [F III]; IG 2, 652 R; IG 2, 656, 18: ὑάλινον ἀργυροῦν, στα[θμ]ὸν τούτου F III; IG 2, 682, 4, 672C; *P. Flind. Petr.* 3, 42, H 7, 3: . . .] ὑάλινον γενέσθαι καὶ ῥυτὸν τριτ . . .

²³ Hero, *Pneumat.* 1, 14, 214, 222, 234; *Dioptric.* 3, 200; Philodemus, *de Morte*, 39, 1ff.; Strabo, 17, 1, 8; Hippocrates, *Epist.* 16 (ed. Kuhn, 3 (1827), 792); *Rev.* 4, 6; 15, 2; Damocrat. (in Galen, 14, 99, 5); Epictetus, 3, 24, 84; Galen, 5, 838; 11, 875; 12, 490; 14, 48, 268, 392; Ael. Promotus (Wellmann, *Corp. Med. Gr.* 10, 1, 1 (1908), 99); Luc. *Ver. Hist.* 1, 25, 27, 42; 2, 11, 14; *Idem, Quomodo Hist. Conscr. sit*, 25; Paus. 2, 27, 3; Philumenus, *de Ven. Animal.* 4, 15 (MS. P has ὑδατι, corrected to ὑάλινω by Wellmann from Aelius Promotus, Περὶ Ἱοβόλων Θηρίων, *Corp. Med. Gr.* 10, 1, 1, 9, 9); Athen. 5, 119F; Ps. Callisthenes, 3, 31; *Inscr. of Cos* (Paton-Hicks (1891)), 36; Hesych. *s. v.* λήκηθος; Damascius (*Patr. Gr.* 103, 1289A); Maspero, *Catalogue Général des Antiquités Égypt.* (1913), 67151, 93 (Testament de Fl. Phoibammôn, Médecin en chef d'Antinoé, Nov. 15, 570; cf. *Id.* (1911), 1, 67097D, 66: ὑάλινω); Paul Aeg. 3, 35, 2; 6, 41, 2; 7, 3; 7, 14, 1; *Id. Chirur.* 348, 368; Theogn. *Canon.* 18, 29 (this last is an error probably caused by copying a corrupt passsge in Hesychius); Bachmann, *Anecd. Gr.* 1, 256; Suid. *s. v.* Θηρίκλειον; Hippiatr. 1, 46, 48; Zonar. *Lex.* 1759; *Etym. Magn.* 774; *Anth. Pal.* 14, 52 (of uncertain date.); Berthelot, *Collection*, 75, 12, note 10; 164; 175, 3; 176, 4; 201, 15; 236, note 15; 350, 1, 2, 3 (bis); 353, 9; 359; 365, 2, 3 (bis); 368, 2, 4, 6; 422, note 6.

are used with about the same degree of frequency. Occasionally they are spelled with a double lambda.²⁵

As the suffix *-ino*²⁶ indicates, *hyalinus* means 'of glass.' In most instances where it occurs, it is used of 'a utensil of glass,' 'a glass cup,' or 'a vessel made of glass.' Just as *hyalos* may stand for some other transparent substance, so *hyalinus* may mean 'of something which looks like glass.'²⁷ Sometimes it is used in imaginary or hypothetical cases, as 'a sea of glass,' 'a glassy humor of the eye.'²⁸ The transparency of glass suggests such examples, as it does the comparison of the air with a glass window.²⁹ Other characteristics of glass suggested by glass objects are hardness and smoothness.³⁰ In a few instances *hyalinus* is employed with an unusual meaning. Josephus (*S.* 1) uses it to characterize sand.³¹ In this case it seems

²⁴ Hero, *Pneumat.* 1, 8, 234, 236, 238, 240, 242; Moschion. *de Mul. Païs.* 116; Dioscorides, 5, 110; Joseph. *Bell. Iud.* 2, 10, 2; Aelian, *Var. Hist.* 13, 3; Galen, 12, 631, 637, 660, 827; 13, 30, 56, 104, 746, 1010, 1045; 14, 293, 403; 406, 539, 568; *Script. de Rebus Alex.* (Müller, Ps.-Callisthenes (1846), 2, 38, 4); Athanasius (*Patr. Gr.* 28, 789B); Basil. *Homil.* 6 (*Patr. Gr.* 31, 1473D); Orib. (Bussemaker-Daremberg, 5, (1873) 199, 11); Titus Bost. *Adv. Manichaeos*, 2, 31 (*Patr. Gr.* 18, 1193C); Cyril, gloss (Hesych. ed. Schmidt, 4 (1864), 341); Alex. Aphrod. *Problem.* 1, 132 (Ideler, 1 (1841), 45); Aëtius, 1, 7 (*Patr. Gr.* 157, 164, or *Scr. Hist. Byz.* 37, 149); Philoponus on Arist. *de An.* 320, 351, 429; on Arist. *Meteor.* 49; Paul. Aeg. 1, 3; 3, 2, 6; 7, 11, 5; 7, 11, 11; 137 (ed. Ald.); Phot. (ed. Por.) *s. v.* θηρίκλειον; *Scr. Orig. Const.* 1, 93; 2, 168; Hippiatr. 1, 103; Theophan. Nonn. 1, 105; *Geopon.* 9, 19, 11; 10, 7, 6; 10, 56, 6; 10, 69, 1; 10, 70; Zonar. *Lex.* 1043; Anon. on Arist. *Rhetor.* 170; *Etym. Magn.* 451, 27; Demetrius, *Hier.* 205, 222; Joan. Actuarius, *de Urinis*, 33, 7; Nemes. *de Nat. Hominis*, 13 (*Patr. Gr.* 40, 665A); Berthelot, *Collection*, 32, 13; 37, 1; 56, 5; 60, 6; 75, 12, note 10; 105; 164, 12; 226, 5; 236, note 15; 250 (bis); 261, 2; 262 (bis); 301, 4; 313, 59; 383, 2; 384, 2; 385, 1; 438, 7; 453, 3 (bis); 4; 454, 6; 455, 11, 14, 15; 456, 18, 20.

²⁵ Luc. *Ver. Hist.* 2, 11 (MS. N, Nilén (1907)); Ps.-Callisthenes, ed. Meusel, 2, 38, N. 42 (quoted in Crönert, *Memor. Gr. Hercul.* (1903), 75); Zonar. *Lex.* 1043.

²⁶ Brugmann-Thumb, *Gr. Gram.* ed. 4 (1913), 194: "Suffix *-ino-*, *-ina-* ist von unklarem Ursprung in Adjectiven, die Stoff, Herkunft, Art bezeichnen."

²⁷ Probably the coffins mentioned in Strabo, 17, 1, 18; Aelian, *Var. Hist.* 13, 3, were simply of some substance that resembled glass (see above, II, c, 2).

²⁸ *Rev.* 4, 6: ἐνώπιον τοῦ θρόνου ὡς θάλασσα ὑαλίνη, ὁμοία κρυστάλλῳ; 15, 2: ὡς θάλασσαν ὑαλίνην μεμιγμένην πυρὶ . . . ἐστῶτας ἐπὶ τὴν θάλασσαν τὴν ὑαλίνην. The comparison with crystal here suggests that transparency was the principal idea in the mind of the author of *Revelations*. Philoponus, on Arist. *de Anima*, 351, 32: ἀλλ' εἰ ἡ λήμη ἐπιτιθεμένη διὰ τὸ μὴ εἶναι διαφανῆς ἀντιφράττει τῷ φωτὶ, ἔδει, εἴπερ ἐπινοηθεῖ ὑαλίνη λήμη ἡ ἐξ ἄλλης διαφανοῦς ὕλης, μὴ ἐμποδίζειν ἐπιτιθεμένην ἐν τῷ ὀφθαλμῷ, ὥστε ὁρᾶσθαι αὐτήν.

²⁹ Athanasius (*Patr. Gr.* 28, 789B).

³⁰ Philoponus on Arist. *de Anima*, 429: ἐὰν σκληρὰ πάνυ καὶ λεῖα σώματα λάβοις, οἷον ὑέλινα ἢ χαλκὰ στιλβωθέντα ἀκριβῶς.

³¹ *Bell. Iud.* 2, 10, 2: τὴν ὑελίνην ψάμμον (ὑελίνην, εἰ. ras. m. 2L ὑαλίνην V R C

to have the meaning 'transparent like glass' rather than 'fit for the production of glass,' which is properly *hyalitis*. Similarly Basilios (*S.* 4) uses *hyalinus* in connection with a membrane.³² It is possible that an anonymous writer on Sancta Sophia has employed *hyalinus* in the same way.³³

j. *Hyalios* (*Hyelios*). The masculine form of the adjective, *hyalios*, appears only with the absurd definition *polemios*,³⁴ probably from a false inference or confusion with *Enyalios*.³⁵ The neuter *hyalion* has the same meaning as *hyalinus*.³⁶

Hyalion is also used as a substantive to stand for glass³⁷ as well as objects made of glass, such as cups,³⁸ mirrors,³⁹ and windows.⁴⁰ It likewise designates the vitreous humors of the body.⁴¹

Niese (1894)). *Thes. Gr. Ling.* 8, 6, and Liddell and Scott cite this passage under *ὑάλικος* and give it the meaning "suitable for making glass." I have been unable to find any authentic instance of *hyalikos* except in a corrupt and as it now stands quite unintelligible passage in Hesych.: *ὑάλικος κώμη Διονύσιος | ὑαλκάδας· χορὸς παίδων· Λάκωνες*, where there is certainly no reference to 'glass.' The form *ὑαλίκην* in Josephus has no MS. authority whatsoever, and is due to a misprint in Haverkamp's 1726 ed. of Hudson's text (London 1720) where *ὑαλίνην* is correctly printed.

³² *Homil.* 6 (*Patr. Gr.* 21, 1473D): *ἐφαίνετο γάρ, ὡς περ φῶς δι' ὑελίνων ὑμένων, διὰ τοῦ ἀνθρωπίνου σώματος ἡ θεία δύναμις.*

³³ Anon. *Διήγησις περὶ τῆς Ἀγίας Σοφίας* (*Script. Orig. Const.* 1 (1901), 93f.): *κατεχρύσωσι ἐξ ὑελίνου χρυσοῦ λαμπροτάτου.* This might mean 'gold, like unto pure glass,' but it is more probably the gold colored glass mosaic so common in early churches.

³⁴ Photius; Bachmann, *Anecd. Gr.* 1, 393: *ὑάλιος· πολέμιος.*

³⁵ Suid. *s. v.* *ὑάλιος· πολέμιος καὶ Ἐννάλιος.* "Mihi videbatur καὶ ἐννάλιος ab homine docto profectum fuisse, qui monstrum vocis animadversum corrigeret," Bernhardt.

³⁶ IG 2, 645: *ὑάλιον ἀργυροῦ γ κο[ῖλον]*, Boeckh. "Fortasse emendandum est *ὑάλι(ν)ον*," Koehler. Suid. *s. v.* *ὑέλιον· καὶ ὑελος, καὶ ὑέλιον.* The latter quotation perhaps more properly belongs below under note 39.

³⁷ Leo Gram. *Chronographia* (*Script. Hist. Byz.* 46 (1842), 215), pieces of glass probably in the form of gems: *τὰ δύο μέγιστα ὄργανα ὀλόχρυστα, διαφόροις λίθοις καὶ ὑελίοις καλλύνας αὐτά.* Cf. Georgius Monachus (*Patr. Gr.* 110, 1009). Demetrius, *Hier.* 275, one of the components of a plaster is *ὑέλιον μέρος ἓν*. Codinus *Curop. de Officiis pal. Constantinop.* (*Patr. Gr.* 157, 40): *καὶ τὸ τοῦτο σκαράνικον τὸν βασιλέα εἰκονικῶς, ἐμπροσθεν μὲν ἰστάμενον ὑπὸ ὑελίου λεγομένου διαγελάσθου.* See below, p. 52, t. Zosimus, 8 (Berthelot, *Collection*, 124): *κατὰ τὸ ὑέλιον.* Note 14: "Il y a en probablement dans un ms. oncial ΚΑΤΑ ΤΟΥΤΟ ΗΛΙΟΥ (κατὰ τοῦ ἡλίου). Réd. de Lc: κατὰ τὸν ἡλιον κτλ." Berthelot, *Collection*, 349, 5: *καὶ ποιήσης αὐτὰ ὑέλια . . . συλλαίνων τὸ ἔλαιον μετὰ τῶν ὑελίων.*

³⁸ Constant. Porph. *De cer. aulae Byz.* 2, 44 (*Script. Hist. Byz.* 9 (1829), 661), gifts sent by the emperor to the king of Italy: *ποτήριον ὀνυχίτου ἁ' ὑέλια κλεοπτ. ιζ'.* On the ε for α see Psaltes, *Gram. der byz. Chron.* (1913), 4, 6. Berthelot *Collection*, 333, 43: *ἐν ὑελίῳ.* *Idem.* 384: *κατάλειπε πλεόν τοῦ ἐκκαίειν τὸ ὑέλιον εἰ γὰρ τοῦτου γενομένου πλεόν ἐθέλεις ἐκκαῦσαι ῥήγνυνται τὸ ὑέλιον.*

In the twelfth century *Hyelion* is mentioned as one of the villages where there was a bridge across the Maeander River.⁴²

k. *Hyalitis* (*Hyelitis*). *Hyalitis* is applied to sand with the meaning 'that from which glass is made.'⁴³

l. [*Hyalkadai*]. See above, note 31.

m. *Hyaloeis*. *Hyaloeis* is defined by Hesychius (*S.* 5)⁴⁴ as transparent and bright. Rufinus (*S.* 6)⁴⁵ uses this form in describing a beauty whose cheeks are like glass.

n. *Hyalomai*. See above, page 38, note 37.

o. *Hyalous* (*Hyelous*). See above page 41, note 3-4.

p. *Hyalôdes* (*Hyelôdes*). Although *hyalinos* and *hyalous* may occasionally denote 'glass-like,' the words which usually convey that meaning are *hyaloeides*,⁴⁶ or *hyeloeides*,⁴⁷ *hyeloides*,⁴⁸ and *hyalôdes*,⁴⁹ or *hyelôdes*.⁵⁰

³⁹ Suid. *s. v.* σπέκλον. τὸ ἕλιον, τὸ σπέτλον. Cf. Damasc. *Stud. Homil.* 25: ἐκῆταξα εἰς τὸ ὑάλιον τὸ πρόσωπον (quoted from Du Cange).

⁴⁰ Anon. Διήγησις περὶ τῆς Ἀγίας Σοφίας (*Script. Orig. Const.* 1 (1901), 12, 90): καὶ διὰ τῶν στοῶν φωταγωγῆσαι τῶν διὰ τῶν ὑελίων ὄντων προσέταξε τὸν μηχανικόν. Salmasius takes σπέκλον to mean window glass. See below, p. 187, n. 4.

⁴¹ Maximus Planudes, *de Morborum Materie* (Ideler, 2 (1842), 318ff.), or τοῦ σοφωτάτου κυρίου Μαξίμου τοῦ Πλανούδη περὶ τῶν ὑελίων πασῶν τῶν ἀσθενειῶν τῶν ἐν τοῖς ἀνθρώποις ἐπερχομένων στίχοι. 1: τῶν ἀσθενέων ὑέλια μάθε τρεῖς καὶ δέκα. 7: ὑελίου κείμενον τοῦ νοσήσαντος παρευθὺς φλεβοτόμησον. 8: τὸ τρίτον ὑέλιον τὸ ῥοδινίζον. 9: ἀλλ' ἄνω τοῦ ὑελίου κέκτεται καὶ τζίπαν ὡς ἐλαιώδη. 24: τὰ ὑέλια ἄνθρωπε καὶ τριῶν τὴν ἰδέαν κατὰμαθε. 28: κριθὲν κάτω μάνθανε τῷ ὑελίῳ αὐτῷ. Niceph. Blemm. *de Lib. Med.* (Heisenberg, *Nic. Blem. Curr. Vit. et Carm.* (1896): "In codice enim Vindob. Med. Graec. 45 saec XIV haec opuscula extant.") 87-3. a. fol. 30^v inci.: τῶν ἀσθενῶν ὑέλια. 3. fol. 35^v inc. (same as above). Uno codice Vindob. Theol. Graec. 245 saec. XV/XVI. fol. 312^r hic titulus praebeatur: διάγνωσις ὑελίων τοῦ οὖρου. See Du Cange *s. v.* ὑέλιον.

⁴² Nicet. Chon. *de Manuele Comneno*, 6, 7 (*Corp. Hist. Byz.* (1835), 33): ἡλανον εὐθὺ τοῦ Ἑλίου καὶ τοῦ Δειμμόχειρος τῶν πολυχρίων, καθ' ἃ περὶ ποταμῷ τῷ Μαϊάνδρῳ πάλα ποτὲ γέφυρα περιήγετο.

⁴³ Theoph. *de Lap.* 49: ἐκ τῆς ὑελίτιδος. See Lobeck, *Paralipom.* 52. Strabo, 16, 758: τὴν ὑαλίτιν ἄμμον . . . ὑαλίτιν ψάμμον . . . ὑαλίτιν γῆν. Eust. *Comm. on Dionys. Periegetes*, 912: ψάμμος ὑαλίτις.

⁴⁴ *S. v.* ὑαλόεν· διαφανές, λαμπρόν. Cf. Theognostus, *Canon.* 18, 29; Zonar. *Lex.* 1760; Philemon, *Lex. Tech.* 248: ὑαλόεν· τὸ διαφανές.

⁴⁵ *Anth. Pal.* 5, 48: καὶ ὑαλόεσσα παρειή.

⁴⁶ Hippocrates (Kuhn, 1 (1825), 289); Theophr. *de Lap.* 5, 30; Rufus, 154, 165, 171, 597; Aët. 2, 20, 12 (Diels, *Doxogr. Gr.* (1879), 349); Galen, 3, 760, 761, 762, 766, 767, 768, 777, 779, 787, 789, 830; 4, 160; 5, 446, 623, 788; 6, 789; 7, 749; 10, 48; 14, 712; 16, 30; 19, 275; Pollux, 2, 71; Euseb. 15, 23; Orib. 3, 294 (from Galen), 295, 296, 298, 301, 302; Orphica, *Lith.* 280 (uncontracted); Theodore, *Gr. Affect. Cur.* 105; Michael Glycas, *Annal.* 1 (*Script. Hist. Byz.* 27 (1836), 40, 3); Berthelot, *Hist.* 2, 136, 75.

As early as the fifth century Philolaus describes the sun as "a glass-like (*hyaloeides*) body which receives the reflected light of the fire in the universe and transmits it to us."⁵¹ Ion of Chios calls the moon *hyloeidê*, "shining, or radiant like glass."⁵² But the physicians make the greatest use of *hyaloeides* and *hyalôdes*⁵³ to describe the various humors and phlegms of the body⁵⁴ and the vitreous humor of

⁴⁷ Aët. 2, 25, 11 (Diels, *Doxogr. Gr.* 356); Ach. Tatius, *Isagoge ad Arati Phaenomen.* 19; Cassius, *Problem.* 154; Stobaeus, 1, 26, 1; Aetius Amid. (Hirschberg, 1); Theophilus, *de Corp. Hum. Fabr.* 4, 15, 3; 19, 5.

⁴⁸ Cassius, *Problem.* 27 (Ideler (1841), 154, 15ff.).

⁴⁹ Hippocrates (Kuhn, 1 (1825), 254); Galen, 6, 255, 509; 7, 138, 347, 349; 8, 81, 82; 10, 870; 16, 11, 367, 585; 17, 1, 429, 848; Palladius, *de Febr. Synopsis*, 8, 1; 27, 2; Paul Aeg. 2, 25; 3, 43, 2; Theoph. *de Urinis*, 8, 2 (Ideler, 1, 269); Leo Phil. *Consp. Medic.* 3, 1; Psellus, *Carmen de Re Medica*, 635.

⁵⁰ Dioscorides, 3, 86 (96); Galen, 13, 942; Meletius, *de Nat. Hominis* (*Patr. Gr.* 64, 1168). Berthelot, *Collection*, 422, 3: ὡς καὶ ἐν τρουλλίῳ τῷ ὑελῶδει πλώματι. Note 6: τῷ ὑέλῳ διπᾶσιον καὶ κατ' αὐτῷ Α.—καὶ (ὡς om.) ἐν ὑαλίνῳ ἀγγείῳ διαπλασίῳ σὺν τῷ αὐτοῦ τρουλλίῳ τίθεται καὶ ἐν αὐτῷ ἀφίεται Ε.—F. 1. ὡς καὶ ἐν τρ. ὑελῷ δίπλωμα τι.

⁵¹ Aët. 2, 20, 12 (Diels, *Doxogr. Gr.* 349f.): Φιλόλαος ὁ Πυθαγόρειος ὑαλοειδῆ τὸν ἥλιον, δεχόμενον μὲν τοῦ ἐν τῷ κόσμῳ πυρὸς τὴν ἀνταύγειαν, διηθούντα δὲ πρὸς ἡμᾶς τὸ τε φῶς καὶ τὴν ἀλέαν, ὥστε τρόπον τινὰ διττοὺς ἡλίους γίγνεσθαι, τὸ ἀπ' αὐτοῦ πυροειδὲς κατὰ τὸ ἐσοπτροειδὲς. Galen, 19, 275; Theodoret. *Gr. Affect. Cur.* 105. Plutarch and Galen omit τὴν ἀλέαν. Ach. Tat. *Isagoge ad Arati Phaenomen.* 19: Φιλόλαος δὲ τὸ πυρῶδες καὶ διανγὲς λαμβάνοντα ἄνωθεν ἀπὸ τοῦ αἰθερίου πυρὸς πρὸς ἡμᾶς πέμπειν τὴν αὐγὴν διὰ τινων ἀραιωμάτων, ὥστε κατ' αὐτὸν τρισὸν εἶναι τὸν ἥλιον, τὸ μὲν ἀπὸ τοῦ αἰθερίου πυρὸς, τὸ δὲ ἀπ' ἐκείνου πεμπόμενον ἐπὶ τὸν ὑελοειδῆ ὑπ' αὐτοῦ λεγόμενον ἥλιον, τὸ δὲ ἀπὸ τοῦ τοιοῦτου ἡλίου πρὸς ἡμᾶς πεμπόμενον. Eusebius, 15, 23: δίσκον ὑαλοειδῆ. Michael Glycas, *Annal.* 1 (*Script. Hist. Byz.* 27, 40): Φιλόλαος δὲ ὑαλοειδῆ τοῦτον ἐφιλοσόφει, δεχόμενον . . . ἡμᾶς. See A. Boeckh, *Philolaos des Pythagoreers Lehren*, 124f.; A. S. Pease on Cicero's *de Div.* 1 (1920), 97.

⁵² Aët. Plac. 2, 25, 11 (Diels, *Doxogr. Gr.* 356): περὶ σελήνης οὐσίας. "Ἴων σώμα τῇ μὲν ὑελοειδὲς διανγὲς, τῇ δ' ἀφεγγές. See p. 65, n. 14.

⁵³ This form of the word was widely used in the Middle Ages and early modern times, see Castelli *Lex. Med.* (1713), s. v. *Hyalodes*.

⁵⁴ Hippocrates, 21, 254: καὶ οὐρου πυώδους καὶ ὑαλῶδους (ὑλῶδους Α). *Idem*, 289: ὠφελεία δὲ καὶ οὐρον διέξοδος ὑαλοειδῆς πολλή, καὶ ῥύσις κοιλίης ῥύσις. Praxagoras in Rufus, 154: Πραξαγόρας δὲ ἴδιον τρόπον τοὺς χυμοὺς ὠνόμαζε, γλυκύν, καὶ ἰσόκρατον, καὶ ὑαλοειδῆ. *Idem*. in Galen, 6, 255: τὸν τοιοῦτον χυμὸν ὁ Πραξαγόρας ὑαλῶδη καλεῖ. On ὑαλῶδη compare Galen, 6, 509; 7, 138, 347, 349; 8, 81, 82; 10, 870; 16, 11, 585. 16, 367: ὃν ὑαλῶδη ἐκάλουν οἱ κατὰ Πραξαγόραν, ὃς ὑάλῳ κεχυμένῳ προσέοικε, τὴν χροῖαν καὶ τὴν σύστασιν. 17, 1, 429: τὸ γονοειδὲς δ' οὐρον λέγεται, ὅταν οὐ καλοῦμενος ὑπὸ Πραξαγόρου χυμὸς ὑαλῶδης ἐκκενοῦται. 17, 1, 848: συμβαίνει δὲ τὰ τοιαῦτα ῥίγη διὰ ψυχρὸν πᾶν φλέγμα τὸ ὑαλῶδες ὀνομαζόμενον ἢ τὸν μελαγχολικὸν χυμὸν, κτλ. Cf. *Idem*, 979. On ὑαλοειδῆς see *Idem*, 6, 789; 7, 749: φλεγματώδης χυμὸς ψυχρὸς, ὃν ὁ Πραξαγόρας ὑαλοειδῆ καλεῖ. Palladius, *de Febr. Synopsis*, 8, 1: ἐπὶ οὖν τοῦ φλέγματος τέσσαρές εἰσι διαφοραί. ἔστι γὰρ τὸ ὑαλῶδες, τὸ ὀξῶδες, τὸ

the eye, the portion back of the crystalline lens.⁵⁵ Besides the sun,

ἀλυκόν, καὶ τὸ γλυκύν. 8, 2: καὶ τὸ μὲν ὑαλῶδες καὶ ὀξῶδες ποιεῖ τὰ ἀνεκθέρμαντα ῥίγη καὶ τῆς ἡπιάλους πυρετοῦς. 27, 2: διὰ τὴν τοῦ χυμοῦ γένεσιν· τὸ γὰρ ὑαλῶδες καὶ ὀξῶδες φλέγμα τὸ ὑποκειμένον ἐστι. Paul Aeg. 2, 25; 3, 43, 2: ὑαλῶδες φλέγμα. Theophilus, *de Urinis*, 8, 2: καὶ ἐτέρας διαφορὰς τοῦ φλέγματος, ὥς ἐστι τὸ ὑαλῶδες φλέγμα καὶ τὸ ἀλυκόν, καὶ τὸ ἄποιον. Theophan. Nonn. 170: κενωθὲν γὰρ ὑαλῶδες φλέγμα, παύονται τῆς ὁδύνης. Psellus, *Carmen de Re Medica*, 596: τοῦ φλέγματος δὲ πολλαπλοῦ πεφυκότος | (τὸ μὲν γὰρ ὡς ὕαλος αὐτὸς τυγχάνει, | τὸ δ' ἀλυκόν πέφυκεν, ὀξῶδες τρίτον, | τὸ δὲ γλυκείας ποιότητός ἐστί πῶς), | ὅπερ πέφυκεν ὡς ὕαλος τὴν φύσιν 635ff: ὁ δ' ἡπιάλος συνθέτως κεκλημένος | ἀμφιμερινῶ σύγγονός πως τυγχάνει, | ἐξ ὑαλῶδους πνεύματος τεταγμένος, κτλ.

⁵⁵ Rufus (ed. Daremberg-Ruelle, 154), on the tunics of the eye: ὁ δὲ τρίτος περιέχει μὲν ὑαλοειδὲς ὑγρόν. καλεῖται δὲ ἀρχαῖον ὄνομα ἀραχνοειδὲς διὰ λεπτότητα . . . ἄλλοι δὲ καὶ ὑαλοειδῆ ἀπὸ τοῦ ὑγροῦ. ὁ δὲ τέταρτος περιέχει μὲν τὸ κρυσταλλοειδὲς ὑγρόν, ἀνώνυμος δὲ ὢν ἐξ ἀρχῆς φακοειδὲς μὲν διὰ τὸ σχῆμα, κρυσταλλοειδὲς δὲ διὰ τὸ ὑγρόν ὠνομάσθη. 171: ὁ δὲ τρίτος ἀπὸ τοῦ αὐτοῦ πόρου προελθὼν περιέχει ὑγρόν [ῥοῦ] τῷ λευκῷ παραπλήσιον καλούμενον ὑαλοειδὲς, κτλ. Cf. *Id.* 597. For a reconstruction of the eye according to Rufus of Ephesus, see *Studies in the History and Method of Science*, ed. Charles Singer, Oxford (1921). Galen, 3, 760: καὶ μὲν γε ὡς εἰς ἑκάτερον αὐτῶν ἐκφύσει ἐγκεφάλου καθήκουσι, πιλούμεναι μὲν κατὰ τὴν διὰ τῶν ὀστέων ὁδὸν ἔνεκα δυσπαθείας, ἐπειδὰν δ' εἰς αὐτοὺς ἀφίκωνται τοὺς ὀφθαλμούς, αἷθις λυόμεναι τε καὶ πλατυνόμεναι, καὶ περιλαμβάνουσai μὲν ἐν κύκλῳ χιτῶνος δίκην τὸ ὑαλοειδὲς ὑγρόν, ἐμφυόμεναι δὲ εἰς τὸ κρυσταλλοειδὲς. καὶ γὰρ καὶ ταῦτ' εἴρηται πρόσθεν, καὶ ὡς αὐτὸ τὸ κρυσταλλοειδὲς ὑγρόν τὸ πρῶτον ἐστιν ὄργανον τῆς ὁψews. Cf. *Id.* 3, 777, 779, 787, 830; 4, 160; 5, 446. 5, 623: εὐρήσεις γὰρ ὑπὸ τοῖς χιτῶσιν ἔνδον ὑγρὰ σφαιροειδῆ διττά, τὸ μὲν οὕτω μαλακόν, οἷα πὲρ ἐστὶν ὕαλος ἢ μετρίως λυθείσα, τὸ δ' οὕτω σκληρόν, οἷος ὁ μετρίως παγεῖς κρύσταλλος. ὀνομάζεται δ' ὑπὸ τῶν ἰατρῶν ὑαλοειδὲς μὲν τὸ μαλακώτερον, κρυσταλλοειδὲς δὲ τὸ σκληρότερον, ἀπὸ τῆς πρὸς ὕαλόν τε καὶ κρύσταλλον ὁμοιότητος, οἷς οὐ μόνον ταῖς συστάσεσιν, ἀλλὰ καὶ ταῖς χροιαῖς ἔοικεν· ἀκριβῶς γὰρ ἐστὶ καθαρά, καὶ διανγῆς, καὶ λαμπρά, κτλ. Cf. *Idem*, 5, 788; 10, 48, 760, 762, 766, 767, 768; 15, 712; 16, 30. Pollux (ed. Bethe, 1900) 2, 70: τὰ μέρη δὲ τῶν ὀφθαλμῶν χιτῶνας ἐκάλεσαν οἱ ἰατροί, τέτταρες δ' εἰσὶ τὸν ἀριθμόν . . . 71: τῷ δὲ τρίτῳ, φακοειδεῖ, καὶ κρυσταλλοειδεῖ, καὶ ὑαλοειδεῖ. Orib. 3, 294ff. (295): καὶ τοῖνον καὶ γέγονε καὶ παρσκευάσται πρὸς τῆς φύσεως ἐπιτήδειος αὐτῷ τροφή τὸ ὑαλοειδὲς ὑγρόν, ὅσῳ παχύτερον καὶ λευκότερον αἷματος, τοσοῦτόν τοι κρυσταλλοειδοῦς ἀπολειπόμενον παχύνηται τε καὶ φανόγηται . . . δῆλον οὖν ὡς κατὰ διάδοσιν τρέφεται, τὸ μὲν κρυσταλλοειδὲς ἐκ τοῦ ὑαλοειδοῦς, τὸ δὲ ὑαλοειδὲς ἐκ τοῦ περιέχοντος αὐτὸ σώματος, τὸ πλατυνθείσης τῆς ἄνωθεν κατιούσης ἐγκεφάλου μοίρας ἐγένετο, κτλ. 297: ὥστε διὰ τῶν μέσων σωμάτων τὸ ὑαλοειδὲς ὑγρόν τῷ πάντων ἔξωθεν ἠνῶται χιτῶνι, τὸ μαλακώτατον τῷ σκληροτάτῳ. 301: οὐδὲν δὲ ἦττον αὐτῆς θαυμάζω καὶ τὴν ἐπιτραφεῖσαν ἐντὸς δασύτητα τῷ περιέξοντι τὸ ὑαλοειδὲς ὑγρόν χιτῶνι· νοτερά γὰρ αὕτη καὶ μαλθακὴ καθάπερ σπογγία, τοῦ κρυσταλλοειδοῦς ὑγροῦ ψαύουσα, τὴν τοῦ χιτῶνος ὅλου γειννῆσιν ἄλυπον αὐτῷ παρέχει. Cass. *Iatr. Problem.* 27 (Ideler, 1, 154): τοῦτο κατὰ δὴλον, ὅτι ὀφθαλμὸς ὑγρὰ περιέχει· τότε ὑδατῶδες, ἀφ' οὗ τὸ δάκρυον, καὶ τὸ κρυσταλλοειδὲς καὶ τὸ ὑαλοειδὲς. Aët. *Amid.* (Hirschberg, 1): ὑγρὰ δὲ ἐστὶν ἐν τῷ ὀφθαλμῷ τρία· ἔνδοθεν μὲν πάντων τὸ περιεχόμενον ἐν τῇ κοιλότητι τοῦ ἀμφιβληστροειδοῦς χιτῶνος ὑαλοειδὲς λεγόμενον, κτλ. Theophilus, *de Corp. Hum. Fabr.* 4, 15, 3 (ed. Greenhill (1842), 152): ἐν γὰρ τῷ ὀφθαλμῷ τριῶν ὕδρων ὄντων, τοῦ κρυσταλλοειδοῦς, τοῦ ὑαλοειδοῦς, καὶ τοῦ ὠσειδοῦς, πρῶτον ὄργανον ὁρατικόν τὸ κρυσταλλοειδὲς

the moon, and humors, a few other things, such as gems,⁵⁶ gum,⁵⁷ and asphalt,⁵⁸ are called 'glass-like.' Objects or substances so designated would seem to be either transparent, occasionally with the additional idea of the consistency of glass in the liquified state, or glistening, or else hard and brittle, as the context requires.

q. *Hyaloma*. *Hyaloma*⁵⁹ is a disease of the eye, glaucoma, in which the vitreous humor becomes opaque.

r. *Hyalops*. See below, page 50, note 8.

s. *Hyalidion*. In Stephanus' *Thesaurus*,⁶⁰ *hyalidion* is mentioned as a gloss and explained by the Latin word *vitriolum*. I have not found either word elsewhere.

5. COMPOUND DERIVATIVES

a. [*Hyelakykades*]. In Crinagoras,¹ in a description of pears offered to Pan, *hyelakykades* occurs. Many emendations have been offered for this form,² most of which agree in suggesting some-

ἐγένετο, τὰ δὲ ἄλλα τροφῆς ἔνεκεν. 4, 19, 5(159): ἡ δὲ λεπτή μήνιγξ σὺν τῷ νεύρῳ πλατυνομένη γεννᾷ τὸν ἀμφιβληστροειδῆ χιτῶνα. ἐπεκτεινόμενος δὲ ὁ ἀμφιβληστροειδῆς χιτῶν περιέχων καὶ τὸ ὑλοειδὲς ὑγρὸν συμπαραλαμβάνει τὸν ῥαγοειδῆ χιτῶνα, περιέχοντα τὸ κρυσταλλοειδὲς ὑγρὸν, καὶ μέρος τι τοῦ ὑλοειδοῦς εἰς τροφήν τοῦ κρυσταλλοειδοῦς. Meletius, *de Nat. Hominis* (*Patr. Gr.* 64, 1168): εἰσὶ δὲ τὰ τοῦ ὀφθαλμοῦ ὑγρά τὸν ἀριθμὸν τρία. καὶ πρῶτον μὲν ἐστὶ τὸ ὑελῶδες· ὃ καὶ κατὰ τὸ μέσον ἔγκειται τοῦ ὀπτικοῦ πόρου· ὅθεν αἱ διεσπαρμέναι ἴνες ποιοῦσι τὸν ἀμφιβληστροειδῆ· καλοῦσι δὲ ὑελῶδες τοῦτο τὸ ὑγρὸν, ὅτι περ παραπλήσιόν ἐστιν ὑέλῳ, κατὰ τε τὸ χρῶμα καὶ κατὰ τὴν σύστασιν, κτλ. Leo Philos. *Conspect. Medic.* 3, 1: εἰσὶ τρία ὑγρά· τὸ ὑαλῶδες λεγόμενον, ἐπειδὴ ὅμοιον ὑέλῳ. For Latin transliterations, see below, p. 59, n. 21ff.

⁵⁶ Theophr. *de Lap.* 30: ἐξ ὧν δὲ τὰ σφραγίδια ποιεῖται καὶ ἄλλαι πλείους εἰσὶν, οἷον ἢ θ' ὑαλοειδῆς ἢ καὶ ἔμφασιν ποιεῖ καὶ διάφασιν, καὶ τὸ ἀνθράκιον, καὶ ἡ ὁμφαξ. Orphica, *Lith.* 280: ἐσθλοὶ δ' αὐτ' ἐπὶ τοῖσι καὶ ὑαλοειδέες εἶναι | κλείονται θνητοῖσι θνητοῖσι τόπαζοι.

⁵⁷ Dioscorides, 3, 86 (96) (*de Euphorbio*): ἔστι δὲ δύο γένη τοῦ ὀποῦ, τὸ μὲν διαυγές, ὡς σαρκόκολλα, κατὰ μέγεθος ὀρόβου, τὸ δὲ τι ἐν ταῖς κοιλίαις ὑελῶδες καὶ συνεστῶς.

⁵⁸ Damocrates in Galen, 13, 942: πυκνῆς τὲ ὑελῶδους πρόσβαλ' ἀσφάλτου β'. Probably brittle and glistening like obsidian (a natural glass).

⁵⁹ Apsyrtus in *Hippiat.* 1, 11: 'Αψύρτου περὶ ὀφθα(λ)μῶν λευκώματος . . . γλαυκώματος δὲ γεγονότος, περιέρχον καὶ τὸ φλεβοτομεῖν. ἔστι γὰρ ἀθεράπευτον. συμβαίνει δὲ ἐκ τούτου ὃ καλεῖται ὑάλωμα, ὅμοιον ψηφίδι, λευκῇ.

⁶⁰ *S. v.* ὑαλίδιον, τὸ, vitriolum, Gl.]

¹ *Anth. Pal.* 6, 232: ὑελακκάδες ὄγχραι.

² See Stadtmueller, *Anth. Gr.* 1 (1894), 351f.: "ἰδ' ὑ ελα_κυ κάδεσ (hyphen C, accentum A C) P | ὑελοκκάδες ap. L. ὑελοκκκάδες Heck. (αἱ μελιπίδακες Geist ὑαλοχρώδες Br. ὑετοκκκάδες Reiske ὑελοοίδακες Toup ὑελομμάδες Picc. εὐ μάλα κυκλάδες Jac. ὑελοχυλάδες Emper.)."

thing glass-like about the pears. Some kinds of ripe pears do, of course, look shiny and semi-translucent.

b. *Hyelepsês*. The glass-smelter is designated by a special word,³ which varies in form and spelling: *hyelepsês*⁴ *hyelepsos*,⁵ *hyalopsos*,⁶ *hyelopsos*,⁷ *hyalops*,⁸ and *hyeloepsos*.⁹ The corresponding form *hyelopsikos*, 'for making glass,' also occurs.^{9a}

c. *Hyelepsos*. See above, note 5.

d. [*Hyelinopoios*]. For some time *yilinopoios*, a word found in an inscription of Sparta of the first century before Christ, was thought to stand for *hyelinopoios*, 'one who makes things of glass,'¹⁰ but the correction of this to *psilinopoios*, 'maker of palm garlands,' is now universally accepted.¹¹

e. *Hyaloeidês* (*Hyeloeidês*). See above, page 46, note 46-47.

f. *Hyeloepsos*. See above, note 9.

g. [*Hyalokeras*]. An error, see above, page 34, note 13.

h. *Hyalotechnês*. See above, page 38; note 36; below note 4.

i. *Hyalourgeion*. See below, note 16a.

j. [*Hyalourgia*]. See below, note 16a.

k. *Hyelourgikos*. See below, note 17.

l. *Hyalourgos* (*Hyelourgos*). Strabo¹² (*S. I*) is the first to mention the *hyalourgos*, or *vitrearius*,¹³ 'glass-maker.' The same form occurs in

³ Friedrich (*Rhein. Jahrb.* (1882), 74, 172); Blümner, *Tech. u. Term.* 4, 384.

⁴ Hesych.: ὑελέψης: ὑέλο . . . "ὑέλο τέχναι Mus., qui compendium superscriptum delevit." Olympiod. on Arist. *Meteor.* 2, 228: παρὰ τοῖς ὑελέψαις. The Aldine edition has a double lambda.

⁵ Michael Glycas, *Annal.* 4, 506, 7: ὁ ὑελεψός. Psaltes, *op. cit.* 4, 6. Cf. Leontius Cyprius (*Patr. Gr.* 93, 1736 D); *Act. Sanct. Iuli. T.* 1, 168, 16; 164, 52 (quoted in *Thes.* under ὑελέψης). Blümner, *op. cit.* 4, 389, n. 2, quotes *Act. Sanct. Iuli. T.* 1, 164, as τοῦ ὑαλεψοῦ, a passage which I have been unable to verify.

⁶ Joan. Moschus, *Prat. Spirit.* (*Patr. Gr.* 87, 2932A): ὑαλοψός. Schol. on Luc. *Lexiph.* 7. Lambros, *Catalogue of the Greek MSS. on Mt. Athos*, 2 (1900), 4503, 32: "Περὶ τοῦ γιάλοψοῦ" (Ἰαλοψοῦ περὶ in Index).

⁷ Cedrenus (*Script. Hist. Byz.* 34 (1838), 687, 1): ὑελοψός. Berthelot, *Collection*, 383: τοῦ ὑελοψοῦ. With double lambda, Herod. *Epom.* 138: ὑελλοψός.

⁸ Pallad. Schol. on Hippocrates, 2, 222: ὁ ὑάλωψ. See Lobeck, *Paralipom.* 291.

⁹ Niceph. Blemm. *de Fabr. Aur. Cod. Reg.* 2329, 159^v: εἰς κάμινον ὑελοεψοῦ, Hase (quoted from *Thes. Gr. Ling.* 8, 6).

^{9a} Zosimus, 11 (Berthelot, *Collection*, 246): ἐν καμνίοις ὑελοψικοῖς.

¹⁰ Welcker (*Bull. Inst.* (1844), 147): Νικοκλῆς ἐκ Τυνδάρου ὑ[ε]λινοποιός. Froehner (1879), 14, 11.

¹¹ Conge-Michaelis (*Annal. dell' Inst.* (1861), 39): ψιλινοποιός. IG 5, 1, 209.

¹² 16, 756: παρὰ τῶν ὑαλουργῶν. See Salmasius, *Plin. Exercit.* 769aE.

¹³ *Corp. Gloss. Lat.*: vitrearius ὑαλουργός. See below, p. 66, b.

a list of traders and artificers in the Tebtunis Papyri,¹⁴ and, spelled with an epsilon, in a Greek papyrus in the John Rylands Library, Manchester,¹⁵ and in extracts from Julian of Ascalon,^{16a} as well as in glosses.¹⁶ Corresponding forms are *hyalourgeion*, *vitraryum*, 'the place where glass is made,'^{16a} and *hyalourgikos*, 'of or for making glass.'¹⁷

m. *Hyalochroos*. Leonidas (*S. III*)¹⁸ speaks of a glass-colored band. It is very difficult for us with our colorless glass to understand what *hyalochroos*, 'glass-colored' means, but most ancient glass, unless artificially colored, has a greenish cast. Among the Romans *vitreus* seems to have been used occasionally to express glass-green,¹⁹ probably in imitation of the Greek, although no instance of such a use occurs in Greek literature. A passage has already been noted where Dioscorides describes resin as 'like glass in color', thinking probably of its translucency.²⁰ It is quite possible that 'glass-colored' refers to the sheerness of the material, especially in view of the fact

¹⁴ 2, 270: ὑαλουργός.

¹⁵ Johnson-Martin-Hunt, 2 (1915), 374, 5: ὑελ(λ)ουργῶν Σχιθews.

^{16a} Const. Harmenopolus, *Manuale legum*, 2, 4, 19: περί ὑελοργῶν . . . ὑελοργούς. Jules Nicole, *Le livre du préfet*, 71, Gen. MS.: περί ὑελλοργῶν . . . ὑελλοργούς.

¹⁶ See below, p. 66, n. 2-5.

^{16a} Diosc. 5, 181: ἐκ τῶν ὑελοργείων. "ὑελοργός, ὁ. vitriarius, qui vitra conficit. Bud. ex Dioscor. [5, 181, ubi hodie ex correct. Sarac. et J. G. Schneideri legitur ὑελοργείων. quod v. Hase]" (quoted from *Thes. Gr. Ling.* 8, 9). Paul. Aeg. 106^v, 10: ἐκ τῶν ὑαλουριῶν. Hase in *Thes.* suggests that this should be written ὑαλοργείων, which seems probable since ὑαλοργία could hardly mean a workshop where glass was manufactured, that seems to be the meaning required here, or in Dioscorides, from whom this passage is quoted. *Corp. Gloss. Lat. s. v.* ὑαλοργεῖον vitraryum.

¹⁷ David, *Proleg. in Porphyr. Isogogen*, 20, 11f.: ὑαλοργική ἐστὶ τέχνη. Cf. Niceph. Blemm. *Epit. log. (Patr. Gr. 142, 697)*. *Georon.* 20, 16: εἰς κάμινον ὑελοργικήν. Berthelot, *Collection*, 36: θὲς εἰς κάμινον ὑελοργικήν. 38, 3: ἡ μαγνησία ἢ ὑελοργική. 307, 38: ἐν καμίνῳ ὑελοργική. 308, 40: εἰς κάμινον . . . ὑελοργικήν. 341, 10: δὸς καμίνῳ ὑελοργικῷ. 347, 1: μαγνησίας ὑελοργικής. 353, 10: βαλὼν ἐν σφαιρίῳ ὑαλοργικῷ. 378, 3: προσχωρεῖ εἰς πήχεις ρ' N° Δ ὑελοργικήν. Note 6: "Δ-signe à lire τέσσαρα . . . ου διὰ (διὰ ὑελοργικήν <τέχνην>, au moyen d'un procédé de verrier).—εἰς πήχεις ρνδ' C." ὑαλοργ. BAK.

¹⁸ *Anth. Pal.* 6, 211, among the things dedicated by Calliclea to Cypris: καὶ μηλοῦχον ὑαλόχροα. Various meanings have been suggested. Dübner (1871) translates "vitricolore," but in the notes gives, "caerulei, subviridis," quoting Brunck who rejects the suggestion of Larcher that the word meant 'transparent.'

¹⁹ Blümner (*Berlin. Stud.* 13 (1892), 218).

²⁰ See above, p. 42, f.

that Varro applied *vitrea* to a toga in this sense,²¹ but it is also possible that a light green hue is meant.

The form *hyelouchri* found in a treatise concerning lead^{21a} is clearly an error.

n. *Hyalopsos* (*Hyelopsos*). See above, note 6-7.

ni. *Hyelopsikos*. See above, note 9a.

o. *Hyelôpizô*. See below, note 23.

p. *Hyalôpis*. The transparency of the jasper is expressed by *hyalôpis*.²²

q. *Hyelôpê*. *Hyelôpê* is a disease of the eye among hawks, and the corresponding verb, describing the condition of the eye in this disease, is *hyelôpizein*.²³

r. *Hylaithos*. Fick²⁴ would derive *Hylaithos*, a river in West Locris, from *hyalos* and *aithô*. The appearance of water would be well described by such a name as 'Glass-shining,' but the etymology is more than dubious, since the first element is not *Hyal-* but *Hyl-*.

s. *Hypohyelion*. The form *hypohyelion*²⁵ seems to mean 'covered over with glass'²⁶ or 'something that looks a little like glass.'²⁷

t. *Diagelaston*. Codinus (*S.* 15)²⁸ also mentions an image of the emperor which was covered with *hyelion* called *diagelaston*, which

²¹ See below, p. 68.

^{21a} Berthelot, *Collection*, 378, 4: καὶ προσχωρεῖ ὑελουχρῆ. Note 13: "ὑελ' λίτρ. (en signe) ρι' BAK (Confusion probable du X avec le signe de λίτρα)."

²² Orph. *Lith.* 613: ἐν γὰρ οἱ δῆεις ὀρώων ὑάλωπιν ἴασπιν | σάρδια θ' αἱματέντα καὶ αλγλήεντα μάραγδον.

²³ Demetrius, Ὀρνεοσόφιον ἀγροικότερον, 122: εἰς ὑελωπὴν ὀφθαλμοῦ. ἐὰν ὁ ἱέραξ ὑελωπίσῃ τοὺς ὀφθαλμούς, οὕτως αὐτὸν νοήσεις . . . ἦλον κυπαρίσσινον λεπτὸν ποιήσας καὶ πυρώσας εἰς τὴν αὐτοῦ ῥίνα ἔμβαλε αὐτὸν ἐκ τρίτου, ὅπου τὴν ὑελωπὴν ἴδῃς.

²⁴ Fick (*Bezz. Beiträge*, 22 (1897), 63).

²⁵ Codinus *Curp. de Officiis Pal. Constantinop.* 4 (*Patr. Gr.* 157, 40, 4): τὸ δικανίκιον τοῦ πρωτοβεστιαρίου χρυσοπράσινον, χρυσοχοϊκόν, ὑποῦελιον (ὑπὸ νιελίου Α).

²⁶ Du Cange, *Gloss. ad Script. Med. et Inf. Graec. s. v.* ὑέλιος, vitreus: "Codinus de offic. aulae Const. c. 4. n. 5 . . . ὑποῦελιον. Cod. alter habet ὑ ὑπὸ ελίου."

²⁷ Gretzerus and Goarus in *Corp. Script. Hist. Byz.* (1839) 18: "Baculus protovestiarii aureo et prasino colore constat, auro fusus est et liquato ad pigmentum metallo collucens." Note p. 236: "p. 18 v. 10. ὑποῦελιον] δικανίκιον protovestiarii aurificio opere χρυσοχοϊκόν, liquatoque viridi ad pigmentum metallo vitrum imitante ὑποῦελιον, ac ideo viride simul ac aureum χρυσοπράσινον." See below, n. 29.

²⁸ See above, p. 45, n. 37. Also *Idem* (*Corp. Script. Hist. Byz.* 37, 20, 18): ἔχον ἔμπροσθεν τε καὶ ὀπισθεν τὴν τοῦ βασιλέως εἰκόνα διαγέλαστον.

has been explained both as a metallic pigment²⁹ and as a transparent glass covering.³⁰ The latter explanation seems the more probable.

D. *Krystallos*.

Since *hyalos*, as I have already shown, is occasionally used for *krystallos*, one might naturally expect to find the reverse, either because glass was actually mistaken for crystal, or because *krystallos* was employed as a figurative equivalent for *hyalos*.¹

The resemblance of rock-crystal to ice, the original meaning of *krystallos*,² led to its being designated by the same word.³ In spite of the similarity of crystal and glass, the latter does not

²⁹ Gretzerus and Goarus translate the first passage: "Liquato ad pigmentum metallo pictam, quod a pellucida vi διαγέλαστον appellatur," and the second: "Habens ante et retro imperatoris imaginem ex liquato ad pigmentum metallo." Note p. 238: "*ib.* v. 15. διαγέλαστου] nonnulli principis imaginem ut arridentem et serena maiestate coruscam διαγέλαστον vocant. an non verius διαγέλαστον ceu risus et laetitiae in spectantibus causam? utrumque ridendum. τὸ διαγέλαστον enim ad materiam ὑελίου, non ad imperatorem βασιλέα referes. at cum ὑποῦελιον pigmentum metallicum sit quod ὑέλιον quoque ob similitudinem cum vitro nuncupatur, διὰ ὑέλιον quoque, quasi διὰ ὑελίου ex vitro conflatum, dici potuit. hinc δια-ὑέλιστον, et ob prolationis affinitatem διαγέλιστον (Portius enim ipse γερανίος vice ἡεράνεος et γιαιλί vice ὑελί, quod est ὑέλιον, scribit) et tandem διαγέλαστον, ut iucundius quoddam et gratius ortum est." *Thes. Gr. Ling. s. v. διαγέλαστος*, ὁ, ἡ: "Pellucidus."

³⁰ Referring to Gretzerus and Goarus, Du Cange, *s. v. διαγέλαστος*: "Neuter, ni ipse fallor, bene: intelligit enim imaginem Imperatoris stantis depictam, ac vitro pellucido tectam."

¹ In Latin poetry *crystallum*, in Blümner's opinion (*Tech. u. Term.* 4, 386), appears not infrequently for *vitrum*, but the *Thes. Ling. Lat.* does not seem to recognize this meaning, at least explicitly. In view of the extreme scarcity of actual rock-crystal among ancient remains, as compared with glass, it appears almost certain that *crystallum* must frequently mean nothing more than glass, but it is difficult to prove this for any particular passage. Thus, for example, it probably would be impossible to show from the great majority of references to it in literature, that in English a 'watch crystal' is not actually made of 'crystal,' but regularly of glass. See below, p. 79ff.

² *Il.* 22, 152 (151): ἡ δ' ἐτέρη θέρεϊ προρέει εἰκνῖα χαλάξῃ | ἡ χιόνι ψυχρῇ ἡ ἔξ ὕδατος κρυστάλλῳ. *Od.* 14, 477 (475): νύξ δ' ἄρ' ἐπῆλθε κακῇ Βορέαο πεσόντος, | πηγυλῖς, αὐτὰρ ὑπερθε χιῶν γένετ' ἥντε πάχνη, | ψυχρή, καὶ σακέεσσι περιτρέφετο κρύσταλλος. Herodotus, 4, 28: ἡ δὲ θάλασσα πηγνυται καὶ ὁ Βόσπορος πᾶς ὁ Κιμμέριος, καὶ ἐπὶ τοῦ κρυστάλλου οἱ ἐντὸς τάφου Σκύθαι κατοικημένοι στρατεύονται καὶ τὰς ἀμάξας ἐπελαύνουσι πέρην ἐς τοὺς Σίνδους. Leo Meyer, *op. cit.* 2, 415; Boisacq, *op. cit.* 522. *Sen. Nat. Quaest.* 3, 25, 12.

³ Strabo, 15, 67, of India: φέρει δὲ καὶ λιθίαν ἢ χώρα πολυτελῇ κρυστάλλων καὶ ἀνθράκων παντοίων, καθάπερ τῶν μαργαριτῶν. *Ael. N. A.* 15, 8: ὁ δὲ ἐν Ἰνδία χερσαῖος οὐ λέγεται φύσιν ἔχειν ἰδίαν, ἀλλὰ ἀπογέννημα εἶναι κρυστάλλου, οὐ τοῦ ἐκ τῶν παγετῶν συνισταμένου, ἀλλὰ τοῦ ὀρυκτοῦ.

seem to have been called crystal in the early literature, at least, but the two are constantly associated.⁴ The adjectival forms *krystalloeides* and *hyaloeides* also frequently occur in close relationship. Some of the early philosophers described the heavens and the heavenly bodies as 'like crystal'⁵ while others preferred to speak of them as 'like glass.'⁶ The physicians designated part of the eye as the crystalline lens, from the character of its humor, and the part next to it as the vitreous humor for a similar reason.⁷

Although Hesychius (*S.* 5)⁸ says that *krystallos* is a 'kind of glass,' if the Greeks occasionally called glass 'crystal' (as the Romans seem to have done, see above, n. 1), it is difficult in any particular passage to be certain of it. In the following instances only does it seem probable that glass was the actual substance which is called crystal. Diodorus (*S.* 1)⁹ composed an epigram upon a piece of carved crystal. Now, in Greece real crystal seems to have been comparatively rare, but by the first century after Christ glass was common. Actual painting upon carved glass or crystal is no doubt possible, but it is difficult, and one might be disposed to think that it would have been hardly satisfactory for a small piece such as this was. I am therefore inclined to think that *chroiê*, the exquisite tinting which reminded the poet of Zeuxis, refers to the beauty of the carved glass, for carved glass was well known and relatively common, while I know of no instance of carved and tinted crystal.

Leonidas of Alexandria (*S.* 1)¹⁰ mentions crystal, silver, and topazes as rich birthday gifts for Agrippina. Here nothing would

⁴ *P. Holm.* i. 5: κρυστάλλου μάλις τραγείῳ αἵματι ζέσας μάλασσε. τὸ δὲ αὐτὸ καὶ ὕελω. Andreas Caes. on *Rev.* 21, 21, see above, p. 28, n. 22.

⁵ *Aët.* 2, 14, 3 (Diels, *Doxogr. Gr.* 344): ('Αναξίμενης) ἤλων δίκην καταπεπηγέναι τὰ ἄστρα τῷ κρυσταλλοειδεῖ. *Id.* 2, 11, 2 (339): 'Εμπεδοκλῆς στερέμνιον εἶναι τὸν οὐρανὸν ἐξ ἀέρος συμπαγέντος ὑπὸ πυρὸς κρυσταλλοειδῶς, τὸ πυρῶδες καὶ τὸ ἀερῶδες ἐν ἑκατέρῳ τῶν ἡμισφαιρίων περιέχοντα. Lactant. *de Opif. Dei*, 17, 6: an si mihi quispiam dixerit aeneum esse caelum aut vitreum aut, ut Empedocles ait, aerem glaciatum, statimne assentiar? *Aët.* 2, 20, 13 (*Doxogr. Gr.* 350): 'Εμπεδοκλῆς δύο ἡλίους . . . τὸν δὲ φαινόμενον, ἀνταύγειαν, ἐν τῷ ἑτέρῳ ἡμισφαιρίῳ τῷ τοῦ ἀέρος τοῦ θερμομυγοῦς πεπληρωμένῳ, ἀπὸ κυκλοτεροῦς τῆς γῆς κατ' ἀνάκλασιν γιγνομένην εἰς τὸν ἥλιον κρυσταλλοειδῇ. Cf. *Diog. Laert.* 8, 77.

⁶ See above, p. 47, n. 51-52.

⁷ See above, p. 48, n. 55.

⁸ Hesych. s.v. κρύσταλλος· εἶδος ὕελ[λ]ου. On the spelling see *Thes.* 4, 2018B.

⁹ *Anth. Pal.* 9, 776: εἰς κρύσταλλον γεγλυμμένον. Ζεύξιδος ἡ χροίη τε καὶ ἡ χάρις· ἐν δέ με μικρῇ | κρυστάλλῳ τὸ καλὸν δαίδαλον. 'Αρσινόη | γράψας τοῦτ' ἔπορεν Σατυρήϊος. εἰμι δ' ἀνάσσης | εἰκῶν, καὶ μεγάλης λείπομαι οὐδ' ὀλίγον.

¹⁰ *Anth. Pal.* 6, 329: ἄλλος μὲν κρύσταλλον, ὁ δ' ἄργυρον, οἱ δὲ τοπάζους | πέμψουσιν, πλούτου δῶρα γενεθλίδια.

suggest that crystal stands for glass except the fact that the author lived in the great center of glass manufacturing in antiquity. Pausanias (*S.* 2)¹¹ says that 'glass, crystal, and morria and everything else made of stone' are broken by the water of the Styx. He is probably thinking of *krystallos* as an artificial product, probably a colorless, transparent glass¹² such as the variety which Strabo (*S.* I)¹³ calls *krystallophanê*.¹⁴ In an epigram upon crystal containing water, Claudian¹⁵ says that it was fashioned by man. It is difficult to understand how a sphere of crystal could be formed so that it could contain water, whereas glass could easily be blown into such a shape.

In an old alchemical treatise, describing the coloring of stones, *krystallos* is mentioned for the production of green glass.¹⁶ Here *krystallos* is no doubt crystal-clear glass suitable for coloring. A similar use of *krystallos* is found in other alchemical formulae.¹⁷

Zonaras (*S.* 12) speaks of a crystalline goblet,¹⁸ probably referring to a crystal-glass goblet, a type of vessel very frequently mentioned by Roman authors (see below, page 79 ff.).

¹¹ Paus. 8, 18, 5: ὕαλος μὲν γε καὶ κρύσταλλος καὶ μόρρια καὶ ὅσα ἐστὶν ἀνθρώποις ἄλλα λίθου ποιούμενα καὶ τῶν σκευῶν τὰ κεραμεῖα, τὰ μὲν ὑπὸ τῆς Στυγὸς τοῦ ὕδατος ῥήγνυται.

¹² Kisa, *op. cit.*, 2, 544.

¹³ Strabo, 16, 758: καὶ ἐν 'Ρώμῃ δὲ πολλὰ παρευρίσκεσθαι φασὶ καὶ πρὸς τὰς χράας καὶ πρὸς τὴν ῥαστώνην τῆς κατασκευῆς, καθάπερ ἐπὶ τῶν κρυσταλλοφανῶν. ὅπου γε καὶ τρυβλίον χαλκοῦ πρίασθαι καὶ ἐκπωμάτιον ἐστίν.

¹⁴ Liddell and Scott define τὰ κρυσταλλοφανῆ as 'glass-ware,' but of course Strabo merely means that one variety of glass, τὰ κρυσταλλοφανῆ, was highly transparent, 'clear as crystal.'

¹⁵ *Anth. Pal.* 9, 753: εἰς κρύσταλλον ἔνδον ὕδωρ ἔχουσιν. χιονέη κρύσταλλος ὑπ' ἀνέρος ἀσκηθεῖσα | δεῖξεν ἀκρασίῳ παναίολον εἰκόνα κόσμου, | οὐρανὸν ἀγκὰς ἔχοντα βαρύκτυπον ἔνδοθι πόντον.

¹⁶ Berthelot, *Collection*, 353, 11: λαβὼν σηρικὸν λίτρας γ', κρύσταλλον καθαρὸν λίτραν α', κασίτεραν ἑξάγια β', λείψον θεία (?) ὥς χοῦν καὶ βάλε αὐτὰ εἰς χυτρίδιον ἄθικτον, καὶ παρόπτα αὐτὰ εἰς κάρβωνα, ἕως γένηται ὕαλος πράσινος.

¹⁷ (*Idem.*, 36, 4: ὁ λίθος μένει κρύσταλλος. 351, 4: καὶ συλλειώσας μετὰ τοῦ ῥηθέντος ἀνωτέρω ὕδατος τοῦ ἐν πῶ σμαράγδῳ, βάλε κρύσταλλον, καὶ βάψεις. 6: καὶ ὅπως ἐνωθέντα τῇ κομάρῳ, βάπτουσι κρυστάλλους ἢ τοὺς φυσικοὺς ἐπιβάπτουσι. 358, 22: καὶ ἔνθες κρύσταλλον λίθον . . . καὶ ἀνακαλύψας εὐρήσεις τὸν ἀπὸ κρυστάλλου ἀλλοιωθέντα λίθον εἰς σμάραγδον. 359, 26: περὶ ἀραιώσεως κρυστάλλου . . . καὶ θεῖς τὰ κρυστάλλα. See also 361, 33, 34, 35, 37; 362, 39, 40; 363, 46, 47. The references quoted are considered as glass by Berthelot, surely the best authority on the subject.

¹⁸ 10, 35, P. 1536 D: ἐπεὶ ὁ οἶνοχόος ἐκείνου κύλικα κρυσταλλίνην κατέαξε.

E. *Morria*

Since there are but two references to *morria* in Greek literature, namely, in the *Periplus of the Red Sea* (S. 1) and in Pausanias (S. 2), while in Latin there is a much more frequent use of *murra*, especially in connection with the *vasa murrina*, both the Greek and Latin sources, as well as the conjectures by modern scholars, will be treated below under *murra*, page 83 ff.

III. THE LATIN WORDS FOR GLASS

A. *Hyalus* AND DERIVATIVES

1. *Hyalus*, the Substantive. The Romans transliterated *hyalos*,¹ the Greek word for glass,² into *hyalus*. Although *hyalus* appears almost as soon as *vitrum*, the common word for glass, and continues in use rather late, its occurrence in literature, at least, is infrequent, being limited chiefly to poetic and scientific works. Moreover, in the passages where the substantive *hyalus* occurs, it does not have the meaning 'glass,' which seems to be attested only in glosses,³ but a 'glass-green color.' Virgil (*S. I*)⁴ writes, "About her the Nymphs were spinning fleeces of Miletus, dyed with rich glassy hue."⁵ When 'glass,' or 'glassy,' is applied to water or the inhabitants of the water, it stands for one or more of the characteristics of water, as transparency, brightness, or color. Servius'^{6a} comment (*S. 4*) that *hyalus* was used by Virgil instead of *hyalinus*, 'hyaline,' *vitreus*, 'like glass,' or *viridis*, 'green,' might be applied to Ausonius (*S. 4*) and Prudentius (*S. 4/5*) likewise. Ausonius⁶ probably had the idea of the sparkling appearance as well as the color in mind when speaking of the Rhine he says, "spread out your robe *hyalo virentem*." In Prudentius⁷ where arches of *hyalus* are compared to meadows bright with spring flowers, there is a possibility that *hyalus* means actual glass, glass mosaic of shining green, or the arches were simply decorated with a glass-green color.

¹ See above, page 22 ff.

² Castellus, *op. cit. s. v. Hyalos*.

³ *Corp. Gloss. Lat.* vitrum. ueles (index = ὑελος). Also yialon vitrum. See below, n. 8b, p. 64.

⁴ *Georg.* 4, 335 (334): eam circum Milesia vellera Nymphae | carpebant hyali saturo fucata colore. On this passage Price, *The Color-System of Vergil (A. J. P.* 4 (1883), 14), remarks: "*Hyalus* . . . physical standard, glass of deep green color."

⁵ Fairclough's translation in *The Loeb Classical Library*.

^{6a} *Ad. loc.*: Hyali Saturo F.C. 'hyali' pro hyalino, vitreo, viridi, nymphis apto. 'Saturo' . . . id est vitreo colore. Note 27: vali A yali reliqui yali V|| hyalino A yalino reliqui.

⁶ *Mos.* 418 f.: caeruleos nunc, Rhene, sinus hyaloque virentem pande peplum. Note: hialo R halo L. Blümner (*Berl. Stud.* 13, 214): "Grünes Glas nennt Ap. Sid. ep. II, 10, 4, p. 14 *vernans crusta*, während bei Aus. *Mos.* 418 *hyalo virens* zu einem Vergleiche dient." Cf. *Idem*, p. 220.

⁷ *Perist.* 12, 53 f.: tum camuros hyalo insigni varie cucurrit arcus, | sic prata vernis floribus reudent.

2. *Hyalus*, the Adjective. *Hyalus* seems to have been used rarely as an adjective also.⁸

3. *Hyalinus*. The adjective *hyalinus*, the Greek *hyalinos*,⁹ 'of glass,' occurs a few times in late Latin literature. Martianus (*S.* 5)¹⁰ mentions glass *pulvis*, 'dust,' and Fulgentius (*S.* 6)¹¹ a glass *sphaera*, 'sphere.' In the life of Saint Wilfridus (*S.* 12)¹² mosaics are described as hiding unadorned arches with a covering of glass. However, just as the Greek *hyalinos* sometimes meant 'like-glass' so *hyalinus* stands for some of the characteristics of glass. Servius' comment on *hyalus* in which he describes it as *hyalinus*, *vitreus*, *viridis* has just been quoted.¹³ Moreover, *hyalinus* is found with the gloss not only of *vitreum*¹⁴ but also of *viridi colore*.¹⁵ Under this meaning of 'glass-green' or 'green' Harper's Lexicon quotes the passage in which Martianus¹⁶ describes wings with *pennis hyalinis*. But since these wings are spoken of also as *remigia aurata*, 'gilded oars,' it seems more probable that the feathers were 'shining like glass' rather than 'green like glass.' In the same author¹⁷ *hyalinus* is used to describe *amictus*, 'outer garments.' Since the other clothes mentioned in this passage are described by some color, it would seem

⁸ *Corp. Gloss. Lat.*: yala vitria. See above, p. 37 f.

⁹ See above, p. 43 f.

¹⁰ 6, 575: parent denique iam ingressurae artis obsequio electissimae feminarum, quae decentem quandam atque hyalini pulveris respersione coloratam velut mensalam gestitantes ad medium superi senatus locum fiducia promptiore procedunt.

¹¹ *Myth.* I praef. 14, 11 (Helm, 1898): musae autem latera sarciebant altrinsecus duae, quarum dexterior uerenda quadam maiestate subnixa elatae frontis polimina argenteis astrorum crispauerat margaritis, cuius faleratum exoticis diadema carbunculis corniculata lunae sinuatio deprimebat ac cerulanti peplo circumlita hyalinae cavitatem sperae* osseo fastigans tigillo versabat. *Sphaerae MHD, sperare T.

¹² Frigidogodus, *de Vita S. Wilfridi*, 15 (*Patr. Lat.* 133, 992 A): nec minus approprant opicizi (*sic*) emblemata proni | arcus incultos hyalino [vitreo] claudere velo.

¹³ See above, n. 5^a.

¹⁴ *Corp. Gloss. Lat.*: yalina vitria. yalinum vitreum. yalium vitr(e)um Graece.

¹⁵ *Ibid.*: hyalinum vitreum, viridi colore. (hyalienum vitrum viricolore (*sic*) before emendation.)

¹⁶ 8, 811: verum alae cum pennis hyalinis et volitandi per mundum remigia crebrius aurata crispantur.

¹⁷ 1, 66: tunc Juppiter publica et quae senatum contracturus assumit indumenta percipiens apponit primum vertici regalis serti flammantem coronam contigitque ex positicis caput quodam velamine rutilante, quod ei praesul operis Pallas ipsa texuerat. dehinc vesti admodum candidae obducit amictus hyalinos, quos stellantibus oculis interstinctos crebri vibratus ignium luminabant.

probable that this garment also had a green tint. However, in the next paragraph¹⁸ the *vestis* is contrasted with the 'dark' *peplum*, which would lead one to think that *hyalinus* here also might mean nothing more than 'bright' and 'shining.'

4. *Hyalodes* or *Hyaloeides*. The only use of *hyalodes* or *hyaloeides*,¹⁹ 'glass-like,' in Latin is one which is very common in Greek,²⁰ namely in the description of the *vitreus humor* of the eye. In Latin the spelling occurs as *hialoides*,²¹ *hylodis*,²² *hyolodotes*,²³ *hiliates*,²⁴ *yelodes*.²⁵

5. *Hyalourgus*. In a gloss *yaluros*²⁶ occurs as a corruption of *hyalourgus*.

6. *Hyale*. For the use of the proper noun *Hyale*, see above, page 40.

7. *Gimalum*. In listing the glosses from the Ripoll manuscript 59, one of a pair of copies of Priscian, of the middle of the tenth century, Burnam says, "*Gimalum*, a word for 'glass,' appears in this statement: *vitrum enim gimalum dicunt*," and suggests that it must be connected with *hyalinum*.²⁷

B. Vitrum

I. ETYMOLOGY

In early Latin literature one may search in vain for any mention of glass, although there is no doubt that the Romans were perfectly familiar with the material itself. It is in Lucretius' *De Rerum Natura*¹ or in Cicero's oration for Rabirius (*S. I*)² that the word

¹⁸ I, 67: nam vestis eius hyalina sed peplum fuerat caligosum.

¹⁹ Castellus, *op. cit.* s.v. *Hyalodes*.

²⁰ See above, p. 47 f.

²¹ Vindic. *Med.* 19: hialoiden B Neu. Theod. Prisc. 4, 2: humorem vitreum, quem Graeci hialoiden vocent. Cf. Octav. Horat. *ad Euseb.* 3, 108.

²² Vindic. *Gym.* 432, l: numerus autem sunt tres. hisquato (*sic*) id est hylodis.

²³ *Id.* 435, d: humoris autem sunt III. sicadotes. hyolodotes. cristaloides.

²⁴ *Id.* 435, p.: humores autem sunt III. sciambitis hiliates. cristallos.

²⁵ *Corp. Gloss. Lat.* vitreum yelodes (Gloss. Servii Gram.).

²⁶ *Id.* yaluros vitriarius.

²⁷ *Miscellanea Hispanica* (Mod. Philol. 12 (1914-15), 167, n. 23): "It must be connected with Gl. E. *Hyalinum*. G here has the palatal value, elsewhere in this MS. written i (in *ienere*)."

¹ 4, 145 ff.: semper enim summum quicquid de rebus abundat | quod iaculentur. et hoc alias cum pervenit in res, | transit ut in primis vitrum . . . | at cum splendida quae constant opposita fuerunt | densaque, ut in primis speculum est, nil accidit horum; | nam neque, uti vitrum, potis est transire, neque autem | scindi. 4,993 (991): praeterea manare aliud per saxa videtur, | atque aliud lignis, aliud transire per aurum, | argentoque foras aliud vitroque meare.

² *Pro Rabir. Post.* 14, 40: fallaces quidem et fucosae e linteis et vitro velatae.

vitrum, 'glass,' first occurs. Its origin is as uncertain as that of *hyalos*. According to Isidore (*S.* 6/7)³ "it is called glass (*vitrum*) because it is transparent to the sight (*visui*) on account of its clearness." Salmasius⁴ following Isidore derives *vitrum* from *vidēre*, 'to see,' asserting (though without quoting any authority) that *vitrum* was once used for *visum* and explaining it as "anything through which one sees clearly." A few later etymologists derive it from the same source through **viditum* and **viditrum*.⁵ However, most modern etymologists who favor the derivation suggested by Isidore consider that *vitrum* comes from the root *vid*, to which has been added *-trum*, the suffix of agency or instrument,⁶ causing it to mean "a means of seeing or of making to see, a transparent thing," that the *d* of the root has been lost so that we have *vitrum* instead of *vidtrum* or *vistrum*, which Bopp says we should expect from analogy to *rastrum*, *rostrum*, *claustrum*, and *castrum*.⁷ To others this derivation does not seem at all probable.⁸

Although a number of other derivations have been suggested, none of them has met with much favor. Isaac Vossius referring to

Blümner, *Term. u. Tech.* 4, 386, note 2: "Dass das Glas selbst lange vorher den Römern bekannt war und es bloss einem Zufall zuzuschreiben ist, dass wir vor Cicero keine Erwähnung desselben besitzen, ist selbstverständlich."

³ *Orig.* 16, 16: *vitrum dictum quod visui perspicuitate transluceat . . . in vitro vero quilibet liquor vel species qualis est interius talis exterius declaratur, et quodammodo clausus patet.* Cf. Rabanus Maurus, *de Universo*, 17, 10; Heracl. 3, 5.

⁴ *Plin. Exercit.* 771a F: "quod et ipsum vitri a video, ut spectrum a specio. nam veteres vitrum pro viso dicebant, ut mertum pro merso. vitrum igitur proprie διοπτρα."

⁵ Schwenck, *Etym. Wörterb. der lat. Sp.* (1827). Valpy, *An Etym. Dict. of the Lat. Lang.* (1828), 514: "Al. from *video*, *viditum*, whence *viditrum* (as *Aratum*, *Aratrum*; *Rutum*, *Rutrum*) then *vitrum*. As being seen through or transparent."

⁶ Regnaud, *Éléments de Gram. Comp. du Grec. et Lat.* 2 (1896), 267.

⁷ *Vergleichende Gram.* 3, ed 2 (1861), 197: "*Vitrum* Glas, gleichsam Werkzeug des Sehens, oder sehen Machendes, hat das *d* der Wurzel verloren. Man sollte *vis-trum* erwarten, nach Analogie von *rastrum*, *rostrum*, *claustrum*, *castrum*." Likewise, Corssen, *Krit. Beitr. z. lat. Formenlehre* (1863), 368; Dwight, *Mod. Philol.* Ser. 2 (1864), 508; Vaniček, *Gr.-Lat. Etym. Wörterb.* 2 (1877), 965: "*vid-(*vid-tru-m)* . . . Werkzeug oder Ding zu Sehen, durchsichtiges Ding." Price, *op. cit.* 4, 14; Fröhde, *Die Entsteh. des ss (Beitr. z. Kunde d. Indogerm. Spr.* 1 (1877), 211); Fumagalli, *Le Principali Etim. della Ling. Lat.* (1889), 249, 252; Sayce, *The Principles of Comp. Philol.* ed. 4 (1893), 355.

⁸ Walde, *Latein. Etym. Wörterb.* (1906), 678; Morin-Jean (Daremberg-Saglio, *Dict.* 5 (1912), 934).

aityron, *hyalon* in Hesychius says that *aitron* comes from *aityron* and *vitrum* from *aitron*, as *Ventus* from *Aentos* and *vinum* from *oinos*.⁹ This passage in Hesychius is interpreted now, however, as perhaps a Grecizing of *vitrum*,¹⁰ or more probably a mistake for *liguron*.^{10a} An attempt to connect *vitrum* with the Greek *hydor*, 'water,' has been equally unsuccessful.¹¹ Probably the greenish color of some antique glass, or the general belief that vitreus sometimes means a greenish color,¹² has led a few to suggest the possibility of deriving *vitrum* from *virēre*, 'to be green,' through *virutum*, which they would change by syncope and metathesis.¹³ A connection between *vitrum*, 'glass,' and *vitrum*, 'woad,'¹⁴ a plant which was used for its blue dye,¹⁵ is noted by several.¹⁶ Some etymologists simply derive them from the same root;¹⁷ others seem to derive the one from the other. Valpy¹⁸ writes that *vitrum* means glass: "also woad, as dyeing with

⁹ Valpy, *op. cit.* 514: "Isaac Vossius refers to Hesych.: αἰτρον, ὑαλον. From αἰτρον, αἶτρον will be vitrum, as from ἀέντος is ventus, οἶνος vinum." See above p. 31, n. 46.

¹⁰ Curtius, *op. cit.* 579; Weise (*Beitr. z. Kunde d. Indogerm. Spr.* 5 (1880), 94); Vaniček, *op. cit.* 2, 965; Walde, *op. cit.* 678.

^{10a} See above, p. 41, n. 51.

¹¹ Morin-Jean, *loc. cit.*

¹² See below, 73 f.

¹³ Valpy, *op. cit.* 514: "Or fr. vireo, to be green; whence virutum, viritrum, vitrum." Ainsworth, *Lat. Dict.* revised and corrected by Ellis (1830): "Fort. a vireo, qu. virutum et per Sync. et Metath. vitrum."

¹⁴ Schrader, *Sprachvgl.* ed. 3 (1883), 270: "Eine diesen Zwecken dienende, in die Urgeschichte Europas zurückgehende Pflanze ist der Waid (*Isatis tinctoria* L.): lat. vitrum, gr. ἰσάτις, got. vizdila, ahd. weit, agk. wâd." Hoops, *Waldbäume u. Kulturpflanzen im germ. Altert.* (1905), 473. Walde, *op. cit.* 678: "Wohl auch gr. ἰσάτις, -idos (**φιτ-σάτις*). Feist, *Kultur, Ausbreitung u. Herkunft der Indogerm.* (1913), 244. Cf. *vitragine*, Orib. *Syn.* 9, 33; *Euporistes*, 2, 185. *Gloss. Thes. Gloss. Emend.* 425: vitraginem eandem esse quam vitriariam dicit Pseud-Apul. c. 81. Wellmann, *Die Pflanzennamen des Dioskurides* (*Hermes*, 33 (1898), 422): "No. 534. KITPAPIAM [vitriariam] = περδικιον C 271". N 118. Ps. Apul. c. 83. Nomen herbae perdelialis . . . Romani vitriariam vocant. D.H. 86, 583s. ἐξίνη."

¹⁵ Caesar, *de Bell. Gall.* 5, 14: se vitro inficiunt, quod caeruleum efficit colorem. Mela, 3, 51: incertum ob decorem an quid aliud vitro corpora infecti. Orib. *Syn.* 7, 1, aa: isatis herba, quam tinctorum herbam vitrum vocant. Cf. *Id.* 7, 1, 2.

¹⁶ Zimmermann, *Etym. Wörterb. der lat. Spr.* (1915), s.v. *vitrum*. See below, n. 17-18.

¹⁷ Schwenck, *op. cit.*: "Vitrum Glas; Waid, ein blau-färbender Kraut (scheint zfgz. aus viditrum von vide). Von diesem Verbo leitet es schon Isidorus ab." Uhlenbeck, *Die Vertretung der Tenuis aspiratae im Lat. (Indogerm. Forschung.* 13 (1902/3), 218): "Lat. vitrum 'Glas, Waid': ai. vyáthate 'schwankt, taumelt, geht fehl.' Ganz unsicher wegen der Bedeutungen."

¹⁸ *Loc. cit.*

a color like that of glass." While Wharton¹⁹ says that *vitrum* means "wood, glass (as of a bluish tint)." Fick²⁰ derives *vitrum* from the root *vit*, 'to tremble, shake; suffer, wither,' connecting it with the Sanskrit *vithura*, 'the fragile, brittle, breakable thing.' Schweizer²¹ suggests that it probably indicates 'shining with a blue color,' and proposes the root *çvi*. Hirt²² connects *vitrum* with the Sanskrit *çvitrás*, 'white,' *çvētás*, 'white, light, shining.' Walde²³ considers this derivation doubtful, and suggests a Northern origin. Since *vitrum* appears in the language long after the substance was known, it might well be a borrowed word, but that leaves its derivation still an open question.²⁴

2. ORTHOGRAPHY AND APPLICATION

Vitrum, unlike the Greek *hyalos*, is neuter;¹ it occurs in the singular² with few exceptions;³ its penult is long⁴ or short⁵ according

¹⁹ *Etyma Latina* (1890), 117.

²⁰ Fick, *Vergl. Wörterb. der Indogerm. Spr.* 1, ed. 3 (1874), 219: "vit, vyat schwanken, zittern; leiden, welken, sskr. vyath, vyath-ate zittern, schwanken; leiden, welken, vyath-â f. Qual, vith-ura zitternd, zerbrechlich, und lat. vit-ru-m m. Glass=sskr. vithura, 'das Zerbrechliche,' vgl. Hesych. ἀτρυα· ὕαλον, doch wohl ἀ-φτρυπο-ν, -lit. vȳs-tu, vȳt-au, vȳs-ti verwelken. -goth. vith-ôn schütteln, englisch to with-er welken." *Id.* 784; 2(1876), 241. See above, note 17. Walde, *op. cit.* 678: "Vitrum nicht . . . zu ai vyáthate 'schwankt'."

²¹ *Zeitschrift f. vergleichende Sprachforschung*, 3(1854), 352: "Nach deren analogie vitrum wohl das bläulich glänzende bezeichnet, wie auch glêsum und unser Glas. Ich denke an eine ableitung von wurz. çvi, die sich dann in çvit erweitert çvēta stammt."

²² *Beitr. z. Kunde d. Indogerm. Spr.* 24 (1899), 290; Pedersen (*Zeitschr. f. vergl. Sprachf.* 36 (1900), 306); Trautmann (*Zeitschr. f. vergl. Sprachf.* 51 (1923), 61).

²³ *Op. cit.* 678: "Vitrum 'Glas'; Verbindung mit ai. çvitrás 'weiss,' çvētás 'weiss, licht,' ab svēt ō 'Licht,' lit. szvaityti 'hell machen,' ahd.u.s.w. (mit idg. d) hwiz 'weiss' . . . ist so lange zweifelhaft, als die Verbindung von queror mit ai. çvāsiti nicht bestimmter widerlegt ist als durch Hirt a.a.O. Zudem kann vitrum (erst seit Cicero) wie glaesum aus dem Norden stammen und ein grm.* hvitradarstellen.

²⁴ Blümner, *Tech. u. Term.* 4, 386: "Das Glas heisst bei ihnen, mit einem etymologisch durchaus unaufgeklärten Worte, *vitrum*." Zimmermann, *op. cit.*: "Vitrum -i 'Glas' erst seit Cic. zu belegen und darum als entlehnt zu betrachten oder mit dem folgenden ['Waid'] gleichzustellen."

¹ *Exc. Bob. Gramm.* 1, 554, 33: nomina quae apud Romanos neutralia, apud Graecos feminina . . . hoc vitrum ὕελος.

² Neue, *Formenlehre der lat. Spr.* 1, ed. 2 (1877), 383f: "Nomina defectiva . . . welche nur im Sing. oder nur im Plur. vorhanden sind . . . Sciendum tamen, quod metallorum vel seminum vel humidorum ad mensuram vel ad pensum pertinentium pleraque semper singularia inveniuntur, ut aurum argentum . . . vitrum."

³ Hero, *de Spec.* 3: in palustribus enim aquis quae in fundo videmus et per vitra

to the demands of meter.⁶ By the eighth century, at least, the form *vetrum*^{6a} also seems to have occurred occasionally. The *e* survives in the words for glass in the Romance languages,^{6b} as Italian *vetro* Spanish *vedro*, and French *verre*.

Perhaps a greater familiarity with glass among the Romans, due to the fact that its manufacture was rapidly becoming important about the time that *vitrum* appears in literature, accounts for the fact that it does not have the diversity of application which we find for *hyalos*. The use of the same appellation for woad has been noted;⁷ but *vitrum*, 'glass,' is applied almost without exception to the actual material which it designates. In one instance it seems poetically to stand for ice,⁸ although *rupes vitri*, 'rocks of glass,' may simply mean rocks as smooth and slippery as glass. In the Middle Ages *vitrum* might be used in the sense of sulphur.^{8a} Other curious definitions for *vitrum* are to be found in the *Lexicon Chymicum* of the *Bibliotheca Chemica Curiosa* (1702).^{8b}

ea que ultra iacent. Isid. Orig. 16, 6: 'numquid alius scit hanc condituram vitrorum?' (vitreorum T). Venant. Vita S. Mart. 4, 84: ne vitra depereant.

⁴ Prop. 5, 8, 37.

⁵ Hor. Od. 3, 13, 1.

⁶ Corssen, *op. cit.* 368; Sayce, *op. cit.* ed. 4, 355.

^{6a} In the section *Decoctio Vetri* of *Compositiones ad Tingenda* (s. 8) as given in Muratori, *Antiquitates Italicae Medii Aevi* 2 (1739), 367, both *vitrum* and *vetrum* occur. A new edition of this work is in preparation.

^{6b} Fumagalli, *Le Prin. Etim. della Ling. Lat.* (1889), 249, 252; Meyer-Lübke, *Romanische Lautlehre in Gram. der Romanischen Sprachen*, 1 (1890), 416.

⁷ See above, p. 61ff.

⁸ Sidon. Carm. 5, 512, 12 (510): iam tempore brumae | Alpes marmoreas atque occurrentia iuncto | saxa polo rupesque vitri siccamque minantes | per scopulos pluviam primus pede carpis et idem | lubrica praemisso firmas vestigia conto. Cf. Doederlein, *Lat. Syn. u. Etym.* 6 (1838), 408: "Vitrum, αἶθρος, die Morgenkälte, wovon πάγος αἶθρος Soph. Ant. 348 das Eis bedeutet." Less likely, Quicherat, *Thes. s.v. vitrum*: "Par ext. Crystal de roche. Rupes vitri Sid."

^{8a} Geber (*Bibl. Chem.* 1, 580): vitri nomine in ista arte saepenumero sulphur significatur, nam sicut vitrum commune omnes colores recipit, lodem quoq. See also *Idem*, 566, 596.

^{8b} Manget, 1, 219: *acureb*, est vitrum. 220: *afformas*, est vitrum. 221: *anathron* vel *anachthron*, species est salis, quod super petras in modu usneae albae et lapideae nascitur, nonnulli sal vitrum appellant. falso putarunt antiqui fel esse vitri, cum sit potius fel lapidum. 221: *anatum*, est vitrum in colore varios liquefactum, quod vulgari vocabulo smaltum appellant, vel terra saracenica. 222: *aludel*, et *alutel*; est vitrum sublimatorium. 223: synonyma—*anatron*, idest *anatron*, est Sal vitri. *anatron*, est faex vitri. *anatron*, est Baurac. *anatron*, est sagimen vitri. *anatron*, est spuma vitri. 225: *atureb*, est vitrum. *azungia* vitri. 226: *baurac*, est sal gemmae saphirium lithargyrum albificatum, est etiam sal vitri, faex vitri, spuma vitri, fel vitri; testudo argenti vivi. 227: *braricia*, est vitrum. 238: *digestio*, est operatio

In some passages *vitrum* merely designates the material with little or no indication of its form;⁹ again it is used to specify the material out of which some particular object is made;¹⁰ or, just as with the Greeks or with us, the name of the object is sometimes omitted and *vitrum* stands for 'a glass,' 'the glass,' or 'a vessel of glass.'¹¹ In all other cases *vitrum* is chiefly a standard for comparison. Things of the widest diversity are compared with glass because of

chymica . . . nonnunquam usurpatur pro furno vel vitro in quo magisterium hoc adimpletur. 241: *fel vitri*, est spuma vitri. est etiam sal vitri, faex vitri. 249: *liquor herbarum*, sit ex herbis confusis, cum tota substantia vitro conclusis. 255: *nitron*, est fex vitri. 270: *vitrum*, vitri 5 genera sunt. (1) ex vitris Europaeis, praestantissima sunt quae Veneta appellantur, et comparantur crystallo. (2) vitra Asiatica, fuerunt pretiosissima Sareptana, appellata Sidonia, comparata fuerunt Electro. (3) recremente vitri, in candido viridia. (4) recrementa vitri rubentia. (5) vitrum quo tinguntur metalla. vitrificatio, est combustio, calces, et cineres in transparens vitrum convertens. vitri fel, spuma vitri, Germ. Glasgall. vitrum nigrum, smalta. 271: *yelion, yalos*, est vitrum. *yru*s, *lagides*, *dasy*pys—est cuniculus masculus, cuius sanguine vitra mollescere pulantur, et etiam silices, modo rebus diaphoreticis, impastetur quod ab imperitis, falso hyrci sanguini ascribitur. 280: *axungia vitri*, cremor seu, flos cristalli. 291: *vitrum*, vocatur—lapis omnium collorum, leo viridis, minor mundus, ovum Philosophorum sager, vas circulare, vas secretum.

⁹ Luc. *de Rerum Natura*, 4, 145, 993; Cic. *pro Rabir.* 14, 40; Varro, *Men.* 382; Plin. 1, 36; 5, 75; 5, 76; 12, 115; 29, 51; 31, 110; 34, 123, 148; 36, 62, 191, 192, 194, 195, 196, 198, 199, 200; Sen. *Nat. Quaest.* 1, 7, 1; *Epist.* 90, 31; Quint. *Inst.* 2, 21, 9; Scrib. Larg. *Comp.* 60; Tac. *Hist.* 5, 7; Solin. 35, 6; *Exc. Bob. Gramm.* 1, 554, 33; Vopisc. *Aur.* 45, 1; *Saturnin.* 8, 10; Marcell. *de Med.* 13, 3; Macr. *Sat.* 7, 16, 23; Hier. *de Incorp. Anim.* (*Patr. Lat.* 24, 6, 1142 A, C). *Vita S. Pauli* (*Patr. Lat.* 23, 72 C); et ipse aquam circumfert et iuxta vitrum (where ed. thinks should be virum, not vitrum); Phoebad. *de Fide Orth.* 8, p. 46 A; Sidon. *Carm.* 23, 53 ff.; *Corp. Gloss. Lat. s.v. vitrum* ueles. *υλαος* vitrum (v m. 2 addidit; a m. 2 pro λ, ut videtur). *yialon* vitrum. *yali*um vitrum Graecae (*Thes. Gloss. Emend.* *yali*um vitr(e)-um Graece). *hyalienum* vitrum viricolore (*Thes. Gloss. Emend.* *hyalinum* vitreum viridi colore); Isid. *Orig.* 16, 16, 1; Hero, *de Spec.* 3; *Vulg. Job.* 28, 17; Soran. 78; *Liber Sacerdotum* (Berthelot, *Histoire*, 1), 104 (bis), 108, 112, 125, 135, 149, 175, 182, 189, 204.

¹⁰ Prop. 4, 8, 37; Plin. *N.H.* 35, 46; 36, 83, 98, 112, 114, 197; 37, 88, 98, 117, 128; Sen. *Epist.* 86, 6; Petron. *Sat.* 55, 6, 10; Stat. *Silb.* 1, 5, 42; Mart. 9, 59, 13; 14, 94, 1; Iuv. 5, 48; Pl. XXVI of Barb. Fol. 19 (Strzygowski, *Jahrb. d. k. d. Arch. Inst.* 1886); Treb. Gall. 17, 5; Lact. *de Opif. Dei*, 8; Hier. *Epist.* 24, 2; 130, 6; Sidon. *Epist.* 2, 10, 4, 15; Le Blant, *Inscr. Chrét. de la Gaule*, 1 (1856), 54, 15; *Carmen. de Mens.* 395; Mart. Cap. 1, 16; Greg. Tur. *de Gloria Mart.* 59; Isid. *Orig.* 16, 15, 27; 20, 10, 7; *Lib. Sac.* 198, 199.

¹¹ *Copa*, 29; Sen. *Nat. Quaest.* 1, 6, 5; cf. 1, 3, 9; Plin. *N.H.* 9, 66; 31, 40; Mart. 1, 37, 2; 2, 40, 6; 3, 55, 2 (L); 4, 22, 5; 4, 85, 1; Treb. Gall. 17, 5; Scrib. Larg. *Comp.* 63, 110; 145; 175 (vitro vel vitreo vase Rhod.); Cels. *de Med.* 7, 18; Evagr. *Sent. (Patr. Gr.* 40, 1284 B); Claud. *Carm. Min.* 51, 1; Hier. *Epist.* 125, 16, 1; 125, 20, 4; Prud. *Cath.* 5, 144; Sulp. Sev. *Dial.* 3, 3, 4; Greg. Tur. *de Mirac. S. Mart.* 2, 32; Venant. *Vita S. Mart.* 4, 78, 84; *Lib. Sac.* 93. Quicherat, *Thes. s.v. vitrum*: "Verre, vase de verre, coupe bocal."

one or more of its characteristics,¹² mainly its bright, shining appearance,¹³ its transparency,¹⁴ its fragility,¹⁵ its sharpness when broken,¹⁶ or its appearance and constituency when molten.¹⁷

3. DERIVATIVES

a. *Vitrarium*. *Vitrarium*¹ occurs as a gloss on *hyalourgeion*, 'the place where glass is made.'

¹² Noel, *Grad. ad Parn.* (1826), *s.v. vitrum*: "Epith. tenue, fragile; clarum, purum, nitidum, lucidum, pellucidum; splendens, splendidum, micans, transparence du verre." Cf. Sintenis and Müller, *Grad. ad Parn.* (1845); Koch, *Grad. ad Parn.* (1867); Quicherat, *Thes.* (1893).

¹³ Ovid. *Met.* 13, 791: splendidior vitro. Hor. *Carm.* 3, 13, 10: fons Bandusiae splendidior vitro. Vitruv. *de Arch.* 2, 8, 10: ita tectoriis operibus expoliti uti vitri per luciditatem videantur habere. Plin. *N.H.* 33, 128: argenti . . . lamnas duci in speciem vitri non nisi ex optimo posse creditum (vitri ego [Mayhoff] fieri 11. v). 36, 61 (on marbles): vitia in iis corneus colos aut candidus et quidquid simile vitro est. Apul. *Met.* 1, 19: haud ita longe radices platani lenis fluvius in speciem. paludis ignavus ibat argento vel vitro aemulus in colorem. Avien. *Ora Mar.* 190 (189): splendore (m) ubique quippe inesse fluctibus | vitri ad nitorem. Val. *Cem. Hom.* 15, 2 (*Patr. Lat.* 52): in comparatione autem paradisi, vitro similis est gemma pretiosior. *Carm. Poet. Min.* 5, 77, 16: cum tamen ora vitro splendidior geras. *Apoc.* 21, 18: ipsa vero civitas, aurum mundum simile vitro mundo. 21, 21: et platea civitatis aurum mundum, tamquam vitrum perlucidum.

¹⁴ Hor. *Carm.* 1, 18, 16: arcanique Fides prodiga, perlucidior vitro. Ovid, *Met.* 4, 355 (354): in liquidis translucet aquis, ut eburnea si quis | signa tegat claro vel candida lilia vitro. Cf. Mart. 4, 22, 5. Sen. *Nat.* 1, 6, 6: quia in nube est aliquid vitro simile, quod potest per lucere. Plin. *N.H.* 11, 153: omnibus membrana vitri modo tralucida obtenditur. 36, 163: in Arabia quoque esse lapidem vitri modo tralucidem, quo utantur pro specularibus, Juba auctor est. *Epist. Sapph.* 157f.: est nitidus vitroque magis perlucidus omni | fons sacer hunc multi numen habere putant. Lact. *de Opif. Dei*, 8. Aristotle, frag. 245 (ed. Rose (1886), 187, 32 ff.): cui consonat quod vulgo dicitur sive dici solet lunam esse quasi vitree [= vitreae] substantie [= -tiae], ut sit susceptibulum lucis solaris. est enim aqua susceptibulum lucis, ut vitrum. Rose notes: "ὑαλοειδές (*de sole Pl. ph.* 2. 20)" = Placita philosophorum—Cf. Diels, p. 47, n. 52 above.

¹⁵ Plin. *N.H.* 13, 140: vitri modo fragiles. 16, 221: vitri modo fragilem. Aug. *Serm.* 18 (*Patr. Lat.* 38, 128, 7): homo vitro fragilior . . . vitrum enim etsi fragile est. See Val. *Cem. Hom.* 10, 2. Venant. 6, 5, 6: sic sumus in statu debiliore vitro. *Lib. Sac.* 149: est enim fragilis plus quam vitrum.

¹⁶ Porph. ad. Hor. *Carm.* 1, 9, 4: utrum ad sensum frigoris pertinet, quod (gelu) velut pungat, an quod fractum velut vitrum acutum sit?

¹⁷ Cels. *de Med.* 7, 7, 13: eoque cavo continet quiddam quod a vitri similitudine ὑαλοειδές Graeci vocant. id neque liquidum, neque aridum est, sed quasi concretus humor. Orib. *Syn.* 9, 56 (Bussemaker-Daremborg, 6 (1876), 389): quam plurime dixit humorem in articulis. est autem pinguis inte similis vitro in pinguidinem.

¹ See above, p. 51, n. 16a.

b. *Vitrarius* (*Vitrearius*, *Vitriarius*), the Noun. *Vitrarius*² (*vitrearius*,³ *vitriarius*)⁵ is used to designate the glass worker.

c. *Vitrarius*, the Adjective. *Vitrarius* also occurs as an adjective in the names of streets and other places, near which the workmen probably plied their trade,⁷ as well as with the meaning 'glass-like.'⁸

d. *Vitreabilis*. The adjective *vitreabilis*⁹ is explained as 'fickle of heart and changeable of mind.' A figurative meaning like this might develop because of the fragile nature of glass, just as in the case of *vitreus*.¹⁰ I have not found this word outside of the dictionary.

e. **Vitreamen* (**Vitriamen*). **Vitreamen*¹¹ (**vitriamen*)¹² occurs in the plural probably for 'vessels made of glass.'¹³

ei. *Vitreatus*. The adjective *vitreatus* is applied to vessels 'of glass.'^{13a} In describing *terra*, it probably means 'glass-like', 'vitreous' or 'glazed'.^{13b}

² Lampr. *Alex.* 24, 5 (*Script. Hist. Aug.*): *vitrariorum* . . . vectigal. Ruricius, *Epist.* 1, 12 (*Corp. Script. Eccles. Lat.* 1891): *vitrarum* . . . cuius opus nitore, non fragilitate oportet imitetur. CIL 6, 29844, 90 (=93); Jordan, *Topogr. d. St. Rom.*, 1, 3 (1907), 219. *Corp. Gloss. Lat. s. v.* ὑαλουργός *vitriarius*. ὑαλουργός. Greg. Tur. *de Glor. Mart.* 10: Judaei cuiusdam vitriarii filius.

³ Sen. *Epist.* 90, 31: cuperem Posidonio aliquem vitrearium. *Cod. Just.* 10, 66 (64), 1 (Krueger, *Corp. Jur. Civil.* 2 (1906)): vitrearii. *Corp. Gloss. Lat. s. v.* ὑαλουργός *vitrearius*. Blümner, *Term. u. Tech.* 4, 386; Forcellini, *s. v. vitriarius*.

⁵ Sen. *Epist.* 90, 31, note 28 (Hense, 1898): "vitrearium mutatum in vitriarium B vitriarium A." *Cod. Theod.* 13, 4, 2: vitriarii. *Cod. Just.* 10, 66 (64), 1 (Herrmann, *Corp. Jur. Civil.* 2, ed. 9 (1861)): vitriarii (ms. Hfn. Azo). *Cod. Rom. Topogr.* 3, 5. Cass. Fel. Med. 20: papyrus vitriariorum. *Ephem. Epigr.* 8, 365, 9 (*ad Corp.* 10). CIL 3, 9542: VITRIARIO. CIL 8, 9430: Antae vitriari. *Corp. Gloss. Lat. s. v. yaluros*, vitriarius. ὑελουργός vitriarius. CIL 6, 4, 29844, 90 (93): P *orticus*? Inter *Vitriarios*?

⁷ *Cod. Urb. Rom. Topogr.* 3, 5: vicum vitriarium. *Ephem. Epigr.* 8, 365, 9: regio clivi vitriari.

⁸ Cet. Fav. 30 (Vitr. ed. Rose (1867), 313, 17): malta vitraria. Forcellini, *Lex. s. v. vitriarius*. On adjectives in -arius, see Rönsch, *Itala u. Vulgata* (1875), 137.

⁹ Mai, *Thes. Nov. Latinit.* 628 (Classicorum auctorum e Vaticanis Codicibus editorum Tomus VIII): vitreabilis, fragilis corde, et mobilis animo. Forcellini, *Lex. s. v. vitreabilis*.

¹⁰ See below, p. 74f.

¹¹ Paul. *Dig.* 33, 7, 18, 13; vitreamina et vesticulam habuerit (Note 6: vitrea minuta ms.). *Corp. Gloss. Lat. s. v.* τὰ ὑάλινα καὶ vitreamina. *Id. Colloquia Monacensia*, 3, 651, 9: vos interim componite diligenter vitreamina. Cf. Haupt, *Opusc.* 2 (1876), 517. On substantives in -men, see Rönsch, *op. cit.* 28.

¹² *Corp. Gloss. Lat. s. v. talia vitriamina* (viatramina ante corr. a).

¹³ Forcellini, *Lex. s. v. vitreamina*.

^{13a} *Lib. Sac.* 85: in vase vitreato pones. 190: sublima eum in vase vitreato. 194: pone . . . in aliud vas terre vitreatum. *Lexicon Chymicum* (*Bibl. Chym.* 1,

f. *Vitreolus*, the Adjective. In the *Carmen* of Paulinus Nolanus (S. 5) the diminutive adjective *vitreolus* is applied to *caliculus*, 'a small cup of glass.'¹⁴

g. *Vitreus* (*Vitrius*), the Adjective. The most common derivative of *vitrum* is *vitreus*¹⁶ (*vitrius*),¹⁷ 'of glass.' But just as in the case of *vitrum*, many figurative meanings based upon the characteristics of glass came into use, especially in poetry, and there particularly in the description of water. Although the *lexica*¹⁸ and our own

226): *barna*, est vas vitreatum. 227: *bonati*, est vitreati. *blumati terreum*, est vas vitreatum. *buccatum*, est vitreatum. 277: *bitrinati*, est vitreatum. See *Idem*. 1, 559; 2, 643, 645, 649, 653, 654, 658; 3, 81, 84.

^{13b} *Idem.*, 119: et pone in vasis vitreis vel de terra vitreata bene opturata.

¹⁴ Paul. Nol. *Carm.* 19, 416 (see below, p. 190, n. 5). Vaniček, *Gr.-Lat. Etym. Wörterb.* 2, 965; Quicherat, *Thes. Poet. Ling. Lat.*; Forcellini, *Lex. s. v. vitreolus -a -um*. See above, p. 49, n. 60.

¹⁶ *Laus Pis.* 193; Ovid, *Amat.* 2, 280; Sen. *Nat. Quaest.* 1, 6, 5; 1, 7, 1; 3, 17, 2; 3, 18, 4 (vas vitreum E); 4, 9; Petron. 34, 6; 51; 67, 10; Plin. *N. H.* 1, 36; 20, 152; 21, 122 (121); 29, 130; 35, 48; 36, 189; 36, 199; Colum. 12, 4, 4; 12, 56, 3; 12, 58, 1; Mart. 6, 35, 3; 7, 72, 8; 14, 112; 14, 115; Calp. *Ecl.* 41; Scrib. Larg. 41, 106, 108, 111, 121, 122, 125, 170, 173, 175 (vitro vel vitreo vase Rhod.); Cels. *Dig.* 33, 10, 7; Javol. *Dig.* 33, 10, 11; Rufinus' translation of Clem. Rom. *Recog.* 7, 12; 7, 26 (*Patr.* 1); Juv. 2, 95; Suet. *Galba*, 18, 3; Dessau, 2, 1, 5173; Tert. *Adv. Marcion.* 4, 205; 4, 209 (Oehler, 2 (1854), 781); Gargilius Mart. *Med.* 41, 43, 212; Lact. *de Ira Dei*, 10, 19; *de Opif. Dei*, 17, 6; Apic. 1, 13; Porph. *ad. Hor. Sermon.* 1, 6, 117; Paul. *Dig.* 33, 10, 3, 3; Paul. *Sent.* 67; Arnob. *Advers. Nat.* 3, 17; *Vulg. Apoc.* 4, 6; 15, 2; Aug. *de Civ. Dei*, 20, 16; *Serm.* 18 (*Patr. Lat.* 38, 128, 7); Orib. *Syn.* 5, 3; Treb. *Gall.* 12, 5; Vopisc. *Firm.* 3, 2; *Schol. Juv.* 2, 95; *S. Silv. Peregrin.* 57; Claud. *Carm. Min.* 43 (75), 1; Plin. *Secund. Jun. de Med.* 1, 6; 2, 4 (ter); 2, 26; 3, 37; Marcell. *de Med.* 14, 57; 20, 92; 36, 72, 73; Cass. *Fel. de Med.* 78; Sulp. Sev. *Dial.* 2 (3), 3, 2; 2 (3), 3, 5 (cf. Venant. *Vita S. Mart.* 4, 349f.); Pelagon. 18, 426, 468; Veget. *Mulom.* 1, 16, 5; 1, 17, 15; 3, 11, 2; 3, 13, 2; 6 (4), 13, 3 (bis); Bachiarus Mon. (*Patr. Lat.* 20, 1045); Paul. Nol. *Carm.* 23, 127; *Vita S. Hil.* 8, 11 (*Patr. Lat.* 50); Ps.-Theod. *Add.* (Rose (1894), 331, 16); Greg. Tur. *de Mir. S. Jul.* 13; Eugraph. *Comm. in Ter. Andr.* 483; Venant. *Carm.* 2, 10, 13; 6, 5, 365; *Vita S. Mart.* 4, 56, 60, 72, 504, 693; *Corp. Gloss. Lat. s. v. ὑάλινη* vitrea. ὑάλινον vitreum. yalinum vitreum. vitreum ὑάλινον; Isid. *Orig.* 16, 6; Pers. *Schol.* 3, 8; Soran. *Gyn.* 131 (Rose (1882), 43, 5); *Act. Petr.* 30; Pallad. *de Re Rust.* 12, 17; Rose, *Anecd. Gr. et Graecolat.* 2 (1870), 306, 19 (Note 20: vitreum 1) *Lib. Sac.* 25, 112 (ter), 126, 178, 185, 187.

¹⁷ Marcell. *de Med.* 7, 52; 20, 126. On the spelling see Moore (*Archiv. f. lat. Lex.* 10 (1898), 254).

¹⁸ Noel, *Grad. ad Parn.* 946: "Vitreus—de verre, ex vitro, crystallinus=transparent. Syn. clarus, nitidus, limpidus. Fragile comme le verre." Ainsworth, *Lat. Dict. s. v. vitreus*: "Of, or belonging to, glass, glassy, glassy green; clear like glass, transparent; brittle like glass." Nork, *Etym. Handwörterb. d. lat. Spr. s. v. vitreus*: "Gläsern; dem Glase ähnlich; am Glanze, daher; hell . . . glänzend, schön; der Durchsichtigkeit nach, daher, dünn . . . in Anbetracht der Zerbrechlichkeit, daher: unbeständig." Leverett, *Lex. of the Lat. Lang. s. v. vitreus*: "Of glass; glass vessels; glassy, like glass—(1) as respects its glittering appearance; hence shining,

familiarity with the appearance of glass furnish an abundance of descriptive words, it is often very difficult to decide just which characteristic of glass is intended. To us 'like glass' may suggest chiefly transparency,¹⁹ but we must remember that the appearance of ancient glass was not always the same as ours, and that glass was common enough and yet new enough to attract the attention of poets as a standard for comparisons of a very wide range. In the majority of cases 'like glass' seems to refer to the shining, bright, sparkling, clear, or transparent appearance of glass, or rather to a combination of these characteristics. Even when a more figurative meaning is suggested, 'bright and shining' is almost always applicable and must have been in the mind of the author if it were not the only connotation intended.

In one of the first recorded instances of the use of *vitreus*, it was applied to a toga. At once the gleaming white toga of the *candidatus* comes to mind, but here Varro says, "the glassy togas expose to view the tunic's purple stripes," and Nonius explains 'glassy' as meaning 'very thin and transparent.'²⁰ Since glass jewelry is so common, the use of *vitreus* in describing gems²¹ is easily understood.

glittering . . . beautiful. (2) as regards its transp. transparent, pellucid . . . thin, fine. (3) as regards brittleness—frail, uncertain, inconstant, precarious. (4) as regards color—green, sea green." Sintonis-Müller, *Grad. ad Parn. Lat.* 4; Koch, *Grad. ad Parn.* 6, s. v. *vitreus*: "Syn. ex vitro, crystallinus, clarus, nitidus, limpidus, pellucidus." Forcellini, *Tot. Lat. Lex. s. v. vitreus et vitrius*: "(1) Adj. a *vitrum*, ad *vitrum* pertinens. (2) Item qui ex vitro est. (3) Vitreus, vitri colorem referens, clarus, pellucidus. Saepè tribuitur aquis. (4) Metaleptice sumitur pro pertenui et perlucido . . . splendida. (5) Item pro fragili, inconstante, instabile." Vaníček, *Gr.-Lat. Etym. Wörterb. s. v. vid-*: "*Vitreus* gläsern, Pl. n. (erg. vasa) Glas-geräthe, -geschirre, (übertr.). Durchsichtig, klar, hell, dünn." Blümner, *Farbenbezeichnungen*, 217: "Klar, hell, dünn, glänzend." *Id.* 218: "Durchsichtig wie Glas . . . durchsichtig, klar." *Id.* 219: "Glasgrün." Quicherat, *Thes. Poet. Ling. Lat. s. v. vitreus*: "De verre. Par ext. De cristal de roche. Syn. Crystallinus. Au fig. Transparent, brillant. Syn. Crystallinus, pellucidus, nitidus, etc. Au fig. Brillant, beau. Syn. Nitidus etc. Fragile comme le verre." Harper's *Lat. Dict. s. v. vitreus*: "Of glass, glass-, vitreous . . . like glass, glassy . . . clear, bright, shining, transparent . . . sea-green . . . brilliant, beautiful, . . . brittle, fragile."

¹⁹ *Corp. Gloss. Lat. s. v. vitreo* [note: vitrea] limpida.

²⁰ *De Comp. Doctr.* 448: vitreum pertenuè et perlucidum, quidquid est, auctoritate veterum dici potest. Varro Modio (313): 'quamst horum, quorum vitreae* togae ostentant tunicae clavos.' *bitae (-te) (bitea C⁴ D⁴).

²¹ Plin. *N. H.* 37, 149: belum autem aliam, quam sic vocant, in Arbelis nasci Democritus tradit nucis iuglandis magnitudine, vitrea specie. 37, 156: cetionides . . . nascuntur, multis coloribus tralucentes, alias vitreae, alias crystallinae, alias iaspidis, sed et sordidis tantus est nitor, ut imagines reddant ceu specula. Solin. 5, 27: haemachates sanguineis maculis inrubescent: sed qui maxime probantur vitream habent perspicuitatem, ut Cyprius.

The shining, reflecting, almost transparent appearance of some fruits²² is familiar. The clear, smooth appearance of the human body sometimes receives the appellation glassy.²³ In the description of water *vitreus* is applied to almost every amount, from the dew drop to the vast ocean.²⁴ In the dew drop or tear drop, in the bub-

²² *N. H.* 34, 123; quibus adhaerescens limus vitreis acinis imaginem quandam uvae reddit.

²³ Claud. *de Raptu Pros.* 2, 53; laeva parte soror vitrei libamina potat | uberis. Sedul. *Pascal. Oper.* 4, 15; cum repente morbosa paludis corporeae unda discessit lacusque vitreae iam carnis exhaustus lymphatae pestis subito vacuatur abscessu.

²⁴ The difficulty of determining just what quality of glass is in each instance uppermost in the author's mind I shall illustrate by an occasional representative quotation, out of scores that might have been cited, from standard commentaries or translations. Verg. *Aen.* 7, 759: te nemus Angitiae, vitrea | te Fucinus unda. Quoted by Quint. *Inst.* 9, 3, 34. Quicherat, *Thes. s. v. vitreus*: "Transp. et brillant." Price, see above, p. 57, n. 4. Hor. *Carm.* 4, 2, 3: Pindarum quisque studet aemulari, | Iule, ceratis ope Daedalea | nititur pennis vitreo daturus | nomina ponto. Mitscherlich (1800): "Viridis coloris, caeruleo." Bothe (1827): "δαλίζω, a colore et splendore." Anthon (1856): "Vitreous is here rendered by some 'azure' but incorrectly; the idea is borrowed from the sparkling of glass." Marshall (1874): "Green sea." Blümner, *Farbenbezeichn.* (1892), 218: "Durchsichtig wie Glas." Bennett (1914): "Crystal." Ovid, *Met.* 5, 48: erat Indus Athis, quem flumine Gange | edita Limnate vitreis peperisse sub undis | creditur. Haupt (1885): "Durchsichtig und grünlich schimmernd wie Glas. Das Glas der Alten hatte gewöhnlich einen grünen Schein." Miller (1916): "Crystal waters." Amor. 1, 6, 55: urbe silent tota, vitreoque madentia rore | tempora noctis eunt. Manil. *Astron.* 4, 515: cum vitreum findens auravip vellere pontum. Colum. 10, 136: vitreoque Siler qui defluit amni. *Epist. Sapph.* 157: est nitidus vitroque magis perlucidus omni | fons sacer. Palmer (1898) on 157: "Vitroque . . . omni Heinsius, Bentley. vitreoque amne libri plurimi. amni Fs, vitroque S, vitroque amnis Naugerius." Sil. Ital. 5, 47: haud secus ac vitreas sollers piscator ad undas. Stat. *Silo.* 1, 3, 73: aut ingens in stagna cadit, vitreasque natatu | pandit aquas. 2, 2, 49: vitreoque natant praetoria ponto. 2, 3, 5: atque habitet vitreum tacitis radicibus amnem. *Theb.* 9, 352: at genetrix coetu glaucarum cincta sororum | protinus icta malo vitrea de valle solutis | exsiluit furibunda comis, ac verbere crebro | oraque pectoraque et viridem scidit horrida vestem. *Ach.* 1, 26: expavit vitreo sub gurgite remos. Mart. 6, 68, 7: numquid te vitreis nudum lasciva sub undis | vidit. 12, 3, 13: fons ibi Castalius vitreo torrente superbit. Plin. *Epist.* 8, 8, 2: fons . . . gurgitem lato gremio patescit purus et vitreus, ut numerare iactas stipes et reluctantis calculos possis. Apul. *Met.* 5, 1: videt fontem vitreo latice perlucidum. Porph. *ad. Hor. Carm.* 4, 2, 3: vitreo daturus nomina ponto . . . vitreo autem ponto id est: vitrei coloris. Iuvenc. *Libr. Evang.* 4, 1, 354: haec memorans vitreas penetrabat fluminis undas. Hil. *de Evang.* 74: oceani ceu forma maris vitreique elementi. Auson. *Ordo Urb. Nobil.* 11, 158: salve, fons ignote ortu, sacer, alme, perennis, | vitree, glauce, profunde, sonore inlimis, opace. *Mos.* 28: ut fluvius, vitreoque lacus imitate profundo. Rossbach (*Berl. philol. Wochenschr.* 29 (1904), 1079: "Die öfters sich wiederholende Bezeichnung des Wassers der Mosel als vitreus 28, 55 u. ö. möchte ich entsprechend der Farbe des antiken Glases und der zu V. 28 angeführten Stelle des Apuleius, *Metam.* 1, 19 lieber durch 'hellgrün' oder 'grünlich' wiedergeben als mit 'kristall hell.'") White (1919):

bling fountain, the still pool, in the small stream, the river or ocean, one need picture only clear, transparent waters with the sparkle of a diamond, as in the case of wine.^{24a} However, since some Latin authors suggest the meaning 'green' for *vitreus*, since the sea is often designated as *caeruleus* and *viridis* as well as *glaucus*, and since impurities often gave ancient glass a greenish tinge, it has been suggested that *vitreus* when applied to water means a sparkling sea-green color. It seems impossible to decide in what instances *vitreus* means 'like crystal,'²⁵ and when it indicates exclusively a sea-green color, if (despite Porphyrio) it ever certainly does.²⁶ *Vitreus* was a stock expression, a poetic word, applied to any amount of water, sometimes merely conventionally to water which was neither crystal-clear nor glass-green, but quite the opposite, as in the case of the Tiber;^{26a} it is even employed in describing waves on a piece of

"Crystal depths." *Mos.* 55: spectaris vitreo per levia terga profundo. 195: et vitreis vindemia turget in undis. 223: reddit nautales vitreo sub gurgite formas. *Drac. Carm. Min.* 2, 78: concussit vitreo sonitus sub fonte puellas. *Claud. Carm. Min.* 26 (49), 32: vitreis [vitreus G] idem lucidus usque vadis. *In Eutr.* 2, 263: vitrei puro qui gurgite Galli. *De Nupt. Hon.* 128: vitreas qui lapsus in undas. *Hier. Vita S. Paul.* 11 (*Patr. Lat.* 23): super vitrei marginem fontis uterque consedit. *Prud. Cath.* 5, 67: circumstans vitreis unda liquoribus. 8, 47: gurgitem vivis vitreum fluentis. *Perist.* 12, 39: vitreas pictura superne tingit undas. *Mart. Cap.* 6, 584: hanc tener et vitreis circumvolitantibus auris | aer complectens imbrificabat aquis. *Paul. Nol. Carm.* 23, 144: in vitreis exile vadis funale coruscat. *Ap. Sidon. Carm.* 22, 43: arentes vitreis adiuvit flectibus undas. 23, 207: tinxerunt vitrei [vitrei C P F, vitreae T] vado Hippocrenes. *Epist.* 1, 5, 8: id est vitrea Velini gelida Clitumni, Anienis caerulea Naris sulpurea, pura Fabaris turbida Tiberis. *Sedul. Paschal. Carm.* 3, 235: libera per vitreos movit vestigia campos. *Paschal. Oper.* 3, 19: perque vitreos salsi marmoris campos. *Claud. Mar. Vict. Alethia*, 1, 154: aetheraque et vitreum pelagus terraque virentes. *Cypr. Ex.* 1033: qua fluit Euphrates vitreis perlucidus undis. *Lev.* 80: ac vitreo sordes diducere rivo. *Boeth. Cons. Phil.* 1, 7, 8 (7): misceat aestum | vitrea dudum | parque serenis | unda diebus. *Coripp. in Laud. Just.* 3, 284: vidimus extensos vitrea testudine pontes. *Ennod. Carm.* 2, 19, 5: effera dum vitreos effundant guttura fontes. 2, 66, 2: et reddor vitrei mancipium pelagi. *Anth. Lat.* 21, 49: vitreo resupinos marmore campos. 39, 1: dum putat esse parem vitreis Narcissus in undis. 211, 12: nec lavat in vitreis hic moriturus aquis. 635, 9: aquae strepentis vitreus lambit liquor. *Venant. Fortunat.* 5, 7, 7: qua tua rura vitrea Liger algidus unda. 6, 5, 233: excipit inde repens vitrea Liger algidus unda. 7, 7, 58: Langona dum vitreis terminus esset aquis.

^{24a} *Coripp. in Laud. Just.* 3, 97: pocula quae vitreo flagrant plena Falerno.

²⁵ *Vulg. Apoc.* 4, 6: mare vitreum simile crystallo. See *Aug. de Civ. dei*, 20, 16.

²⁶ There are, of course, many instances in which the color may be in mind, but I know of none in which that is the only possible meaning.

^{26a} *CIL* 9, 4756: Ostia :Tybris ibi vitreus, Nar hic fluit albus. Cf. *Id.* 11, 2, 1, 4188; *Bücheler, Carm. Lat. Epigr.* 2, 1327, 7.

tapestry.^{26b} Its use extends further than the description of water; it is applied to the nymphs who dwell in the water.²⁷ Here again the question arises whether *vitreus* corresponds to *caeruleus* or *glaucus*, for both are used in describing sea deities. The glassy tresses²⁸ of the nymphs might be sea-green like sea weed or, though less likely, a gleaming yellow. The caverns and abodes of the nymphs were *vitreus*;²⁹ their looms³⁰ and the wool³¹ they spun were glassy. *Vitreus* used in describing the inhabitants of the sea, their abodes, and work seems to be a transferred epithet. There is really nothing in a figure swimming under water which resembles glass; caverns below the water away from the sun's rays do not reflect the gleam of their shining pebbles. Are not 'glassy nymphs' dwelling in 'glassy caverns' nothing more than beautiful nymphs who glide through glassy waters to abodes beneath the crystal or sea-green waves? If one must apply *vitreus* to the appearance of the object described, just as in the case of water, it can always mean sparkling and transparent and sometimes it seems to indicate sea-green,³² but it is impossible

^{26b} Claud. *de Raptu Pros.* 1, 269: coeperat et vitreis summo iam margine texti | Oceanum sinuare vadis.

²⁷ Auson. *Mos.* 179: ad commune fretum Satyros vitreasque sorores. Cf. Stat. *Theb.* 9, 351: glaucarum sororum. CIL 8, 7759: sallit et loco vitrea Nafis.

²⁸ Stat. *Silv.* 1, 5, 16: ite, deae virides, liquidosque advertite vultus | et vitreum teneris crinem redimite corymbis.

²⁹ Verg. *Geor.* 4, 350: vitreisque sedibus omnes | obstipuerunt. Sil. It. 7, 413: cum trepidae fremitu vitreis e sedibus antri. 8, 191: suscepit gremio vitreisque abscondidit antris. See Rupert's note (1798) on 4, 346: viridi . . . antro: "Vitreus, ut ὑάλινος, ὑαλόεις, viridis, color vitri antiqui et maris." Stat. *Silv.* 3, 2, 16: surgite de vitreis spumosa Doridos antris. Serv. ad Verg. *Geor.* 4, 350: vitreisque sedibus ergo vellera similia esse debent, ubi perlucidus et caeruleus est color. Drac. *Carm.* Min. 2, 130: herbida quo vitreum tellus perfuderat antrum. Claud. *Fesc.* 2 (12), 34: sub vitreis Oceanus | luxuriatur antris [undis V₁]. Cons. *Hon.* 146: vitreisque sub antris.

³⁰ Id. *Olyb. et Prob.* 225: Ilea percurrens vitreas sub gurgite telas. Jacob, *Quaest. Epic.* (1839), 82: "Vitreus . . . non semper significat id quod est ex vitro, sed etiam quod vitri colorem habet . . . vitreas telas appellavit vitreas ob viridem maris aquam. Quae ipsi colorem quasi viridem tribuere visa erat." Platnauer (1922): "Crystalline loom."

³¹ See above, p. 57, n. 4-5a; p. 59, n. 25.

³² Blümner, *Farbenbezeichn.* 218: "In der grössern Zahl der Fälle ist aber die Bedeutung keineswegs so von vornherein gegeben, vielmehr ist da fast überall ebenso gut die Bedeutung 'hell, klar wie Glas' als 'grün wie Glas' möglich; denn letztere überhaupt zu statuieren, ist wohl sicher erlaubt, da das gewöhnliche Glas der Alten zweifellos ebenso gut, wie heut gemeines Glas, eine grünliche Färbung hatte. . . . Alle diejenigen Stellen, in denen man sonst ebenso gut die Bedeutung 'durchsichtig wie Glas' als 'grün wie Glas' an und für sich annehmen könnte, beziehen

to determine where one of these meanings must be used to the exclusion of the other. Water in the solidified form of frost and ice is still 'like glass,'³³ *i. e.*, shining, glistening. Finally we have in the Vulgate translation of the Apocalypse^{33a} a vision of a sea of glass.^{33b}

In all of the passages hitherto cited the chief idea has been transparency coupled with an almost equal emphasis upon the shining appearance. There are, however, a few instances in which the shining, sparkling quality is chiefly emphasized.³⁴ But here just as

sich auf das Wasser." 219: "Zieht man in Betracht, dass die Nymphen und speciell ihre Haare sonst bei den Dichtern gern als blau, grün oder blaugrün, d. h. von der Farbe des Wassers, geschildert werden, und dass dies auch von den zu ihnen gehörigen Gegenständen oder Attributen gilt, so ist es nur durchaus wahrscheinlich, dass in der Mehrzahl der hier angeführten Fälle *vitreus* wirklich direkt 'glasgrün' und nicht 'glashell' bedeutet." 220: "Wir können demnach *vitreus* ruhig unter die Farbenbezeichnungen für grün aufnehmen, freilich mit der Beschränkung, dass eben nur ein glasartiges, glänzendes Grün darunter zu verstehen ist."

³³ Ovid. *Her.* 10, 7: tempus erat, vitrea quo primum terra pruina | spargitur. Zeno, *Tract.* 1, 6, 2: undique vitreis armatum montibus. Venant. Fortunat. 5, 11, 6: per glaciem vitreas me loquor isse vias.

^{33a} 15, 2: et vidi tamquam mare vitreum mixtum igne, et eos . . . stantes super mare vitreum. Cf. Incerti Auctoris *Adversus Marcionem*, 5, ed. Oehler in ed. of Tert. II, 781f., IV, 205: ad solium domini vitreum et mare stare sub igne . . . 209: nam vitreum flammae mixtum mare dona lavari spiritu conflato credentibus esse tributa. See above, p. 70, n. 25. Bachiarus Monachus, *Liber ad Januarium, de Reparatione Lapsi* 9 (*Patr. Lat.* 20, 1045): mare illud (hoc est, forma baptismi) quod beatus Joannes in Apocalypse vidisse se dicit, vitreum fuisse descripsit (*Apoc.* IV, 6; XV, 2); et ideo in nobis cito periclitatur aut frangitur. Farrar in Smith's *Dict. of the Bible*, 1 (1860), 704: "In the N. T. glass is alluded to as an emblem of brightness." Mathews in Hastings' *Dict. of the Bible* (1909): "Sea of glass . . . The probability is, however, that there is no distinct symbolism whatever, but that the reference is rather to the brilliancy of the waters as one element in the supremely beautiful land of heaven."

^{33b} This is, however, only a translation from the Greek, and illustrates merely Greek usage (see above, p. 28, n. 26).

³⁴ Pers. *Sat.* 3, 8: turgescit vitrea bilis. *Schol. ad loc.*: id est ira vitrea, id est viridis, perspicua, quod iratus intelligitur ex vultu. ira enim virides et pallidos facit homines. vitrea, quae cito apparet, ac velut aliquid apparet, quod in vitreo vase ponas, ita qui cholera patitur, cito paret. *Schol. ad Hor. Serm.* 2, 3, 141: splendida bilis, quae omnia in lucem profert. Persius (3, 8): vitrea bilis [quia numquam stat]. aliter: 'splendida,' lucida, quia nemo potest irasci ita, ut non appareat eius iracundia. Conington-Nettleship, *Persius*, ed. 3 (1893), 51, note 8: "Translation of *θαλῶδης χολή*, the expression in the Greek med. writers (Casaubon). splendida bilis Hor. 2, 3, 141." However, I have not found the expression *θαλῶδης χολή* in the Greek medical writers, and there is no indication of such a combination under either of the words in the *Thes. Gr. Ling.* Auson. *Ordo Urb. Nobil.* 11, 161: vitrea non luce Nemausus | purior. White (1919): "Azure sheen." *Carm. Poet. Min.* 5, 77, 15: ora facis vitreo

in the case of water above, there is the question of whether or not the idea of greenness enters in. To the shining quality of glass is sometimes added the idea of the reflection of a glassy surface.³⁵

As we have seen above, 'green,' or 'sea-green,' has been considered as one of the designations for *vitreus*. Such a meaning is given in Servius,³⁶ in scholia,³⁷ and glosses.³⁸ The difficulty, however, lies in applying this meaning. As we have seen in the case of water and objects pertaining to water, and in the case of grain and herbage, there is not an instance where another meaning has not been or could not be used. There remains one example in which Pliny³⁹ refers to the *vitreus color* of the sea urchin, which is, of course, sea-green. This does not, however, prove that *vitreus* in itself suggested the idea 'green' to a Roman, any more than 'glassy' in English would mean 'green,' despite the fact that the expression 'the color of glass' would suggest that idea, for the essential connotations of the word are 'bright, shining, smooth, fragile.'

It is with reference to the brittleness and fragility of glass that the greatest number of figurative employments of the word are to be found, although here also general agreement in regard to conno-

tibi splendidiora nitore. *Anth. Lat.* 83, 66 (B. 271, 66): vitreas ligat herba comas. Note on line 66: "virides *Burman* ligat erba A, leuat (*vel rigat*) *Higt.*, agit *Maehly*." Blümner, *Farbenbezeichn.* 218: "Freilich ist mir nur eine, und noch dazu späte, Stelle bekannt, wo die Bedeutung 'glasgrün' allein möglich ist; es ist das *A. L.* 271, 66, wo es vom Grase heisst." But even this passage by no means settles the question, since Chubb, *An Anonymous Epist. of Didoto Aeneas* (1920), 66, p. 33, translates: "The grain binds its shining tresses," and in a note adds: "*Vitreas . . . comas*: of the grain bound into sheaves. *Vitreas* refers to the brilliant semi-transparent appearance of ripe grain." Certainly if *ligat* refers to the binding of sheaves, and I do not see what else could be thought of here, then the *vitreae comae* cannot possibly be green, for grain is not cut and bound for threshing while in that condition. Ennod. *Carm.* 1, 8, 39: oh quotiens vitreis Heliconis fluxit in herbis | adridens labiis quae facit unda sitim! Here the *vitreae herbae* might suggest plain green herbage, but it is quite as natural, and imaginatively more effective, if the poet meant 'bright, sparkling grass,' i.e., the dewy, glistening grass by the margin of a spring or watercourse. Venant. Fortunat. 11, 10, 7: intumuit pullis vitreo scutella rotatu.

³⁵ Plin. *N. H.* 37, 156, see p. 68. n. 21. Claud. *de Raptu Pros.* 3, 268: vitreae tardatur imagine formae. Platnauer (1922): "She is checked by the mirrored image of her own form." Paul. Nol. *Carm.* 23, 176: sub vitrea nigri latet albus imagine pupi.

³⁶ See above, p. 57, n. 5a.

³⁷ *Schol. ad Pers.*, see above n. 34.

³⁸ See above, p. 58, n. 15.

³⁹ *N. H.* 9, 100: echini . . . nec omnibus idem vitreus colos. Leverett, *Lex. of Lat. Lang. s. v. vitreus*: "As regards color—green, sea-green—Plin. *color*."

tations has not always been reached. Perhaps there are more different meanings given for Horace's expression, 'glassy Circe,'⁴⁰ than for any other one use of *vitreus*. The scholiasts were perplexed about this passage. Porphyrio^{40a} suggests that *vitrea* is a rather poor expression for *candida*, 'a shining, dazzling white' or 'bright,' and Pseudo-Acro⁴¹ gives three choices, 'beautiful,' 'glittering,' or 'a neighbor of the sea,' clearly showing that he was uncertain just what to do with it. Moreover, since '*vitrea Circe*' is mentioned in contrast with the faithful Penelope, and in Statius (here obviously following Horace and showing how he, surely the very best authority, understood the passage) even the very hills of her island are called *perfida*, it is clearly her faithlessness and inconstancy that are to be understood as emphasized. Although many scholars have followed the scholiasts, interpreting *vitrea* as glittering, beautiful, or both,⁴² or as an appellation showing some relationship with the sea, and often including the former meaning,⁴³ Statius,⁴⁴ an in-

⁴⁰ *Carm.* 1, 17, 20 (19): *dices laborantis in uno | Penelopen vitreamque Circen.*

^{40a} *Ad. loc.*: *vitream Circen parum decore mihi videtur dixisse pro candida.*

⁴¹ *Ad. loc.*: *aut pulchram aut procurato lucentem nitore aut mari vicinam.*

⁴² I give a few typical notes and translations of modern scholars to illustrate the uncertainty as to the precise meaning. Mitscherlich (1800): "Docte et audacter pro marinam; nam erat Nereis, et mari vicina habitabat . . . ob vulgarem apud veteres vitri colorem, viridis, caeruleus . . . Vel sic tamen praeferam non multorum interpretationem, tamquam exquisitiorem, poetaeque adeo digniorem, qua Circen a pulchritudinis splendore vitream, Graecorum exempla secutus, dixerit." Bothe (1827): "Pulchritudine splendentem." Nork, *Etym. Handwörterb. d. lat. Spr.* (1838), *s.v. vitreus*: "Dem Glase ähnlich, am Glanze, daher: hell . . . Circe, Hor. i.e. glänzend schön." Heindorf (1843): "Vitrea Circe, kein Beiwort der Circe als Meeresgöttin, denn dies ist sie nicht, sondern den splendor pulchritudinis bezeichnend, wie im Griech. *ὁάλινος παῖς ὁαλέη ὄψις*." Leverett, *Lex of the Lat. Lang.* (1849), *s.v. vitreus*: "Hor. (*vit. Circ.*) h.e. beautiful." Dillenburger (1881): "Splendidam instar vitri et formosam, sed quae cum splendore vitri fragilitatem coniungat. Alii vitream dictum volunt Circen ab aquae colore caeruleo, *ὁάλινω* ut 4, 2, 3, quia Circe nympa erat marina aut certe insulam incolens." Finlayson (1891): "Circe's gleam." Nauck (1894): "Die glänzende, strahlende: nach dem sie umgebenden Elemente, der krystallinen Meerflut, 4, 2, 3. Die andere Erklärung von *vitreus* als unzuverlässig ist doch wohl nicht haltbar. Im folgenden Gedichte, 5, 16, ist das Glas, welches das darunter Liegende durchscheinen lässt, das Symbol der Unzuverlässigkeit, die Geheimnisse nicht zu bewahren weiss." Bryce (1896): "Beauteous Circe." Godley (1898): "Bright Circe." Smith and Greenough (1898): "Crystal, suggesting a brilliant, dazzling beauty. . . . The epithet is perhaps applied to her as a sea-goddess, see *Odys.* 10, 274 ff." Green (1903): "Crystal Circe." C. L. and J. C. Dana (1908): "Circe glittering as a summer sea." See notes 43-45. Cf. Hor. 1, 5, 12 f.: *miseri, quibus | intemptata nites.*

⁴³ Moore (1850): "An epithet applied to all marine deities, on account of the color of the water; 'sea-green.'" Orellius (1850): "Quippe quae nympa marina,

comparably better judge of meaning than the scholiasts, apparently saw in *vitrea* another characteristic of glass, namely its fragility,^{44a} or rather a quality of instability, uncertainty, inconstancy, faithlessness, derived from the brittle, fragile nature of glass, a meaning not foreign to Horace (see below, note 46). Glass is beautiful to look upon, but one can put no faith in its stability. This interpretation, now accepted by many scholars,⁴⁵ seems the most fitting for both *vitrea Circe* and the following passages. Unstable, like a beautiful, sparkling object of glass which is to be admired one moment and all in ruins, broken in pieces, the next, are fame,⁴⁶ fortune,⁴⁷

certe insulam habitans, ab aquae colore *ὑάλινω*, caeruleo. ut c. 4, 2, 3 . . . qui explicant: 'nitentem, candidam ac propterea formosam' . . . minime autem interpretare possumus: 'fragilem (in amore), infidam.'" Ritter (1856): "est caerulea, a colore vitrei ponti 4, 2, 3, quo circumfluitur Circes insula." Chase (1870): "(Splendida, formosa), 'Crystal Circe,' as a sea-goddess, from the glassy element which surrounds her. C., with singular inaptness, lugs in modern metaphors in his explanation 'glassy, i.e., beautiful but frail.'" Mueller (1882): "Weil sie eine Meeresgöttin ist." Küster (1890): "Heisst Circe, weil sie eine Nympe des *vitreus pontus* 4, 2, 3." Blümner, *Farbenbezeichn.* (1892), 220 [Glasgrün]: "In diesem Sinne haben auch manche unter den neueren Erklärern die *vitrea Circe* des Horaz gefasst; und dass ist jedenfalls auch viel besser als darunter 'glänzend wie Glas' oder gar, was auch versucht worden ist 'zerbrechlich also vergänglich wie Glas' zu verstehen." Coutts (1898): "Circe of the glassy sea." Page (1898): "Vitream] 'glassy-green': all sea nymphs are represented as of the color of sea-water. So they are called caeruleae; the Greek word is *ὑάλινος*." Wickham (1903): "Glass-green Circe." See notes 42-45.

⁴⁴ *Silv.* 1, 3, 85: *vitreae iuga perfida Circes*.

^{44a} Francis (1889); Cudworth (1917): "Frail." Probably the transparency rather than the fragility of glass caused Marris (1912) to translate: "Circe pale."

⁴⁵ Anthon (1856): "'And glass-like Circe,' i.e. as bright and dazzling, but, at the same time, as frail and as unworthy of reliance as glass." Marshall (1874): "The epithet may simply be employed to mark Circe's connection with the sea, like the 'mater caerulea' of Epod. 13, 16, or, more prob., it unites the idea of glittering and deceptive, as in Sat. 2, 3, 222." Forcellini, *s.v. vitreus* 5: "Item pro fragile, inconstante, instabili . . . vitream Circe; h.e. cuius in Ulyssem amor quasi fragilis fuit, et parum durans. Alii aptius exponunt, splendidam, formosam." Rosenberg (1898): "'Unzuverlässig' genannt." Kiessling (1917): "Kirke ist unzuverlässig und trügerisch wie das gleissende, aber leicht zerbrechliche Glas. Meergöttin ist K. nie gewesen." See notes 42 and 43. Quite the opposite of fragility is seen in Naylor's unusual comment (1922): "The epithet suggests the immortal."

⁴⁶ Hor. *Sat.* 2, 3, 222: *quem cepit vitrea fama, | hunc circumtonuit gaudens Bellona cruentis*. Porph. *ad loc.*: *aut fragilis, aut splendida*. Paul. Nol. *Epist.* 8, 3, 18: *at vitreo fert cava fama sinu*, where Paulinus clearly shows that he understood Horace to have suggested the fragility and hollowness (*cava*) of fame. On Horace—Bothe (1822): "Pulchra." Nork (1838), *s.v. vitreus*: "In Anbetracht der Zerbrechlichkeit, daher: unbeständig fama." Howes (1845): "Bubble fame." Keightly (1848): "Glassy, i.e. dazzling." Leverett (1849), *s.v. vitreus* 3: "Frail,

and wealth,⁴⁸ one's pleasures,⁴⁹ and opinions,⁵⁰ even life itself.⁵¹ When ankles⁵² are designated as 'glassy,' they are no doubt thought of as weak and fragile, since the ankle is notoriously the most vulnerable spot in the human anatomy.

The glassy humors⁵³ of the eye and body receive their designation from their resemblance to the appearance and constituency of liquid glass.

uncertain, inconstant, precarious (Hor. vit. fama)." Moore (1850): "'Dazzling'; it means, literally, 'glassy,' and might here signify 'fragile,' 'transitory.'" Maclean (1853): "It probably means . . . the glitter of fame." Juvencius (1855): "'Vitro fragilior.'" Anthon (1867): "Glassy fame—translated *vitrea* properly, means here, as bright and yet as fragile as glass." Schütz (1889): "Zerbrechlich wie Glas." Mueller (1891): "Vitrea (βάλεος) kann glänzend entweder den Glanz oder die Gebrechlichkeit des Ruhmes andeuten." Palmer (1891): "'Glassy,' perhaps combining both the glitter and brightness of glass." Orellius (1892): "Falso splendore nitens, atque eos nos decipiens." Quicherat (1893), *s.v. vitreus*: "Fragile comme le verre." Krüger (1897): "Glänzend." Rolfe (1901): "Glittering and perishable." Wickham (1903): "The key to the epithet is perhaps to be found in a verse quoted among the so-called 'sententiae' of Publilius Syrus It then covers both the explanations that the scholiast gives as alternatives." Kiessling (1906): "Weil sie so gleissend und zugleich so zerbrechlich ist wie Glas." Plessis and Lejay (1911): "Brillante et fragile." Ussani (1916): "Cio è luminosa e fragile come il vetro."

⁴⁷ Publil. Syr. *Sent.* 189: fortuna vitrea est: tum cum splendet frangitur.

⁴⁸ Licent. *Carm. ad. August.* 105: nam neque propter opes vitreas, aurumque rebelle.

⁴⁹ Aug. *de Civ. Dei*, 4, 3: ut vitrea laetitia comaretur fragiliter splendida, cui timeatur horribilius ne repente frangatur, de imperii latitudine ac magnitudine velle gloriari.

⁵⁰ Aug. *Contra Jul. Pelag.* 1, 4, 12 (*Patr. Lat.* 44): quae tuorum argumentorum vel acies vitrea, vel plumbei pugiones in illorum conspectu exseri audebunt. 1, 9, 46: vitreas argutias tuas, et fragilia, quibus tibi multum videris acutus et nitidus, argumenta confringam. *Contra Sec. Jul. Respons.* 1, 119 (*Patr. Lat.* 45): altitudine iudiciorum eius cedat vestrorum crepula ruina verborum, quasi nitida et acuta, sed vitrea. Vigil. Thaps. *Contra Euty.* 5 (*Patr. Lat.* 62): vitreasque sententias veritatis malleo obterendas.

⁵¹ Commod. *Inst.* 1, 26, 17 (Dombart, *Corp. Script. Eccl. Lat.* 15 (1886)): et dicis vitam, ubi vitrea vita moraris? Note 17: "Mortalis D. Oehl: (*idem in comm. 'malim'*: Et dicis vitam uti vitrea vita mortales?)." Weyman, *Zu den Sprichwörtern u. sprichwörtl. Redensarten d. Röm.* (*Archiv. f. lat. Lex.* 13 (1902/4), 405).

⁵² Sidon. *Epist.* 3, 13, 9: taceo femur aridum ac pandum, genua vasta poplites delicatos, crura cornea, vitreos talos, parvos digitos, pedes grandes.

⁵³ Vindic. *Med.* 19: infusa per humorem vitreum, quem Graeci βάλοειδῆ vocent. Theod. Pris. 4, 2; Octav. Horat. *ad Euseb.* 108, see above, p. 59, 21. Isid. *Orig.* 11, 1, 20: visus est qui a philosophis humor vitreus appellatur. Rufus, *Extraits de Rhazès* (Daremborg-Ruelle (1879), 496, 256, 2): ciboria ex quibus generatur flegma vitreum.

A late and unusual use of *vitreus* remains to be noted. This is in an inscription to an artisan of the *vitrea ars*.⁵⁴ Probably this is the same as our expression 'glasswork,' for the manufacture of glass articles. This man's trade was glasswork or the business of making glass.

h. *Vitreus*, the Substantive. *Vitreum* (*vitrium*), the neuter of the adjective, is used substantively, sometimes interchangeably with *vitrum*,⁵⁵ 'glass,' more often, however, for an object made of glass. Generally this object is a glass vessel.⁵⁶ With this meaning the adjective usually occurs in the plural form, *vitrea*⁵⁷ (*vitria*)⁵⁸, 'glass vessels,' 'glassware,' and probably because of this greater frequency of use, generally only the plural of the substantive occurs in modern lexica.⁵⁹ The worthlessness of broken glass gives to *vitrea fracta*, 'broken glassware,' the figurative meaning of 'mere trumpery,' 'nonsense.'⁶⁰ In some instances the exact nature of the glass object

⁵⁴ Orell. 4299 (=CIL 13, 2000; Dessau, 7648): opifici artis vitriae. Note: "Vitriae i.e. vitriariae."

⁵⁵ On *vitreum*—Lucr. *de Rerum Nat.* 4, 602 (601): perscinduntur enim, nisi recta foramina tranant, | qualia sunt vitrei, species qua travolat omnis. Cf. the use of *vitreorum* in Petr. 51 and *vitrorum* (*vitreorum* T) in Isid. *Orig.* 16, 16, 6. *ὑαλος* in Iren. *Contra Haereses*, 1, 2, is translated *vitreum* in an old Latin version. Tert. *ad Mart.* 4 (*Patr. Lat.* 1, 626 B): Si tanti vitrum? (Note 8: Tanti vitreum? Rhen). Vopisc. *Aurel.* 45, 1: vectigal . . . vitrei (B P M). Chiron, *Mulomed.* 529: vitrei similitudinem in oculis habebunt. 531: quod efficit similitudinem vitrei. Corp. Gloss. Lat. s. v. *ὑαλος* hoc vitreum [vitrum e] vitreus. *vitreum* *ὑελος*. *ὑαλος* and *ὑελος* might be used adjectively here, however; see above, p. 37. On *vitrium*—Chiron, *op. cit.* 11: vitrium [nitrium B] tusum ferragini aspergis. 536: in ipsa pupilla quomodo vitrium habebit. 806: claucoma si habuerit in media pupilla, quomodo vitrium [nitrium].

⁵⁶ Sen. *Nat. Quaest.* 3, 18, 4; *de Ira*, 1, 12, 4; Plin. *N. H.* 28, 173; Scrib. Larg. 175.

⁵⁷ Mart. 1, 41, 5; Petron. 50, 51; Stat. *Silv.* 1, 6, 74; Plin. 12, 100; 37, 29; Ulp. *Dig.* 37, 7, 12, 28; Paul. *Dig.* 37, 7, 18, 13 (Note 6 on *vitreamina* gives: "vitrea minuta MS."); Lampr. *Heliog.* 27, 4; Vopisc. *Tac.* 11, 3; *Origo Rom. Chron.* 1, 146, 3; Isid. *Orig.* 16, 6; *Lib. Sac.* 175.

⁵⁸ *Origo Rom. Chron.* 1, 145, 17. On *vitria* in the Chronographers, see Frick (*Archiv f. lat. Lexikogr.* 6 (1889), 566). Corp. Gloss. Lat. s. v. *yalina* vitria. *yala vitria vitrica* (index 425: "Sine interpr. vitrea?").

⁵⁹ Ainsworth, s. v. *vitrea*: "Glasses." Leverett, s. v. *vitreus*: "Glass vessels." Vaniček, s. v. *vid*: "Vitreus . . . Pl. n. (erg. vasa) Glas-geräthe, geschirre." Quicherat, s. v. *vitrea*: "Objets en verre; verre cassé." Forcellini, s. v. *vitrea*: "Sunt vasa vitrea." Harper's *Lex.* s. v. *vitrea*: "Glass vessels, glassware." Georges, ed. 8, s. v. *vitreus*: "Subst., vitreum, ei, n., das Glasgeschirr . . . Plur. vitrea."

⁶⁰ Petron. 10, 1: an videlicet audirem sententias, id est vitrea fracta et somniorum interpretamenta? See Forcellini and Harper's *Lex.* s. v. *vitrea*. Mart. 1, 41, 4; Stat. *Silv.* 1, 6, 74, might be classified with this meaning. Panckoucke, *Oeuvres Complètes de Stace*, 1 (1828), 108, note 17: "Cruceus dit qu'en latin cette

is unknown,⁶¹ at other times *vitreum* seems to stand for both 'a glass gem'⁶² and 'a window.'⁶³

The feminine form, *vitrea*, is used by Gregory of Tours⁶⁴ to designate a window, probably because the gender of *fenestra* is feminine.

i. *Vitrinarius*. *Vitrinarius* designated the 'seller of glass.'⁶⁵

j. *Vitrinus*. In Philon a vessel is spoken of as *vitrinus*, 'of glass,' instead of *vitreus*, although one manuscript does have the latter reading.⁶⁶

k. *Vitrosus*. *Vitrosus* also has the same meaning as *vitreus* according to Mai.⁶⁷ I have not found this word in ancient literature.

l. *Vitrificator*. Sittl⁶⁸ notes the use of *vitricator*, 'glassmaker,' in Beda (*S.* 7/8), in a passage which I have been unable to verify. Presumably the form given is an error for *Vitricator*, the next entry.

m. *Vitricator*. The compound form *vitricator*, as well as *vitricator*, occurs in Bede⁶⁹ and Cuthbert (*S.* 8).⁷⁰ The forms *vitricare*,⁷¹ *vitricatio*,⁷² and *vitricatoria*,⁷³ all words which seem to occur first in the Middle Ages, have the same composition.

expression, *des verres cassées*, s'emploie métaphoriquement pour désigner des choses de peu de valeur." However, I believe actual glass was meant (see below, p. 106ff).

⁶¹ *Corp. Gloss. Lat. s. v. ὑάλινον* vitreum. *vitreum ὑάλινον*. *yalinum* vitreum.

⁶² Plin. *N. H.* 36, 98; 37, 128, see below, p. 145; Tert. *ad Mart.* 4, see below, p. 147, n. 21. The Latin version of Iren. *Contra Haereses*, 1, 2: quoniam lapidem pretiosum smaragdum magni pretii apud quosdam, vitreum in eius contumelia per artem assimilatum.

⁶³ *Symphos. Aen.* 68 (*Poet. Lat. Min.* 4 (1882), 378): vitreum | perspicior penitus nec luminis arceo visus, | transmittens oculos ultra mea membra meantes; | nec me transit hiems, sed sol tamen emicat in me (vitrium s). See below, p. 187, n. 4.

⁶⁴ Greg. Tur. *Hist. Franc.* 6, 10: his diebus basilica Sancti Martini a furibus effracta fuit. qui ponentes ad fenestram absidæ cancellum, qui super tumulum cuiusdam defuncti erat, ascendentes per eum, effracta vitrea sunt ingressi. *De Glor. Conf.* 96: ante vitream absidæ . . . membra sedebat. *De Glor. Martyrum*, 59: si aliud, inquit, invenire non possum, vel has ipsas quas cerno vitreas auferam, fusoque metallo aliquid auri conquiram mihi. ablatis igitur dissipatisque vitreis, metallum abstulit. *De Mir. S. Jul.* 27: confringi passus est vitream, non catervam.

⁶⁵ *Corp. Gloss. Lat. s. v. vitrinarius* vitrum vendens.

⁶⁶ Rose, *Anecd. Graecolat.* 2 (1870), 306, 19: si fuerit vas illud vitrinum vel corneum. Note 20: "corneum vel vitreum I." Sittl (*Archiv. f. lat. Lexikogr.* 6 (1889), 110): vitrinus=vitreus. Georges, *Lex. s. v. vitrinus*.

⁶⁷ Mai, *Thes. Nov. Latinit.* 628; Forcellini, *Lex. s. v. vitrosus*.

⁶⁸ *Loc. cit.*: "vitricator Beda H. d. s. p. 334."

⁶⁹ See below, p. 113 7b.

⁷⁰ See p. 114, n. 7c.

⁷¹ Manget, *Bibl. Chym.* 1, 313; 2, 502, 691, 698.

⁷² *Idem*, 1, 334, 2, 692, 698.

⁷³ *Idem*, 2, 524, 536, 573, 595, 609.

C. *Crystallus*

The Greek *krystallos*, as we have seen, probably stands for glass at times, but it is hard to be sure of the matter in any particular instance.¹ In the majority of cases, the same statement might be made concerning the Latin transliteration, *crystallus*, masculine and feminine, or *crystallum*, neuter (*chryst-, christ-, crust-, crist-*).²

Pliny devotes considerable space to the traditional origin of crystal, to some of its sources, to its uses, and to the most noted objects made from it, and concludes by stating that "glass vessels have become incredibly like these (crystal vessels), but in such an unusual way that they have increased their own value and not brought down that of crystal,"³ an indication, doubtless, that the

¹ See above, p. 53f.

² For the different spellings, see Lambertz in *Thes. Ling. Lat.*

³ *N. H.* 37, 23ff.: contraria huic causa crystallum facit, gelu vehementiore concreto. non aliubi certe reperitur quam ubi maxime hibernae nives rigent, glaciemque esse certum est, unde nomen Graeci dedere. oriens et hanc mittit, quoniam Indicae nulla praefertur. nascitur et in Asia, vilissima circa Alabanda et Orthosiam finitimisque, item in Cypro, sed laudata in Europa Alpium iugis. Iuba auctor est et in quadam insula Rubri maris ante Arabiam sita nasci, quae Necron vocetur, et in ea, quae iuxta gemmam topazum ferat, cubitalemque effossam a Pythagora Ptolemaei praefecto; Cornelius Bocchus et in Lusitania perquam mirandi ponderis in Ammaeensibus iugis, depressis ad libramentum aquae puteis. hoc mirum, quod Xenocrates Ephesius tradit, aratro in Asia et Cypro excitari; non enim reperiri in terreno nec nisi inter cautes creditum fuerat. similis veri est, quod idem Xenocrates tradit, et torrentibus saepe deportari. Sudines negat nisi ad meridiem spectantibus locis nasci. quod certum est, non reperitur in aquosis, quamquam in regione praegelida, vel si ad vada usque glaciuntur amnes. e caelesti umore puraque nive id fieri necesse est; ideo caloris inpatiens nisi in frigido potu abdicatur. quare nascatur sexangulis lateribus, non facile ratio iniri potest, eo magis quod neque in mucronibus eadem species est et ita absolutus laterum levor est, ut nulla id arte possit aequari.

magnitudo amplissima adhuc visa nobis erat quam in Capitolio Livia Augusti dicaverat, librarum circiter CL. Xenocrates idem auctor est vas amphorale visum, et aliqui ex India sextariorum quattuor. (nos liquido adfirmare possumus in cautibus Alpium nasci adeo inviis plerumque, ut fune pendentes eam extrahant.)—peritis signa et indicia nota sunt. infestantur plurimis vitiis, scabro ferumine, maculosa nube, occulta aliquando vomica, praeduro fragilique centro, item sale appellato. est et rufa aliquis robigo, aliis capillamentum rimae simile. hoc artifices caelatura occultant. quae vero sine vitio sint, pura esse malunt, acenteta appellant, nec spumei coloris, sed limpidae aquae. postrema auctoritas in pondere est. invenio apud medicos, quae sint urenda corporum, non aliter utilius uri putari quam crystallina pila adversis opposita solis radiis. alius et in his furor, HS centum quinquaginta milibus trullam unam non ante multos annos mercata matre familias nec divite. Nero amissarum rerum nuntio accepto duos calices crystallinos in suprema ira fregit inlisos. haec fuit ultio saeculum suum punientis, ne quis alius *his* biberet. fragmenta sarciri nullo modo queunt. mire his ad similitudinem accessere vitrea, sed prodigii modo, ut suum pretium auxerint, crystalli non deminuerint.

output was very small, and that, therefore, the process of manufacture was difficult and expensive. Elsewhere Pliny mentions glass made of crystal,⁴ and says that the glass most highly prized most nearly resembled crystal.⁵ This is the glass "clear as crystal" of Strabo (*S.* I),⁶ the "clear glass which is like crystal" of Scribonius Largus (*S.* 1) and Marcellus (*S.* 4),⁷ and the inspiration for the "sea of glass like unto crystal" of the Apocalypse.⁸ It is interesting to note the greater degree of familiarity with transparent glass in a gloss of a later date, where crystal is described as "a kind of rock similar to white glass."⁹ When this gloss was written, transparent glass was evidently much more common than crystal, which had always been rare, and had been mentioned so often in connection with glass, no doubt, not because it was common but because it was the best word to describe or stand for this new type of transparent glass. At first glass was clouded with imperfections, and the manufacture of clear, transparent glass was an extremely important step in the development of glass making. Naturally crystal glass would be much more unusual, rarer, and more easily confused with rock crystal than at present. In most instances where *crystallum*, or *crystallina*, is used, it is impossible to determine whether glass or crystal is meant, but especially among the Roman poets cups of crystal are mentioned very frequently, while we know that crystal was rare, and, as far as I am aware, no vessel of it has come down, although numerous wonderfully wrought glass cups and vases have been preserved. The fact that some of the objects could be made easily in glass while it would be well-nigh impossible to make them in crystal, and that some of the vessels are brought from Egypt, the greatest glass manufacturing center, makes it seem all the more probable that *crystallum* was used for glass and *crystallina* for objects made of glass. Since objects made of *crystallum*, *crystallina* in particular, mentioned so frequently after transparent glass became

⁴ See below, p. 98, n. 10.

⁵ *N. H.* 36, 198f.: maximus tamen honos in candido tralucentibus, quam proxima crystalli similitudine. usus eorum ad potandum argenti metalla et auri pepulit. *Isid. Orig.* 16, 4: maximus tamen honor in candido vitro, proximoque in crystalli similitudine; unde et ad potandum argenti metalla et auri pepulit vitrum. Cf. Rabanus, *de Universo*, 17, 10.

⁶ See above, p. 55, n. 13.

⁷ See below, p. 180, n. 13^a.

⁸ 4, 6: et in conspectu sedis tamquam mare vitreum simile crystallo.

⁹ *Corp. Gloss. Lat.* 5, 448, 31: crystallum: genus saxi in similitudine vitri albi. (cristallum in similitudine bitri alui. Note 31: vitri *ab*).

known, are clearly of glass in some instances and probably of that material in most of the others, the more important references to them will be treated at this point.

When Pliny speaks of imitating gems, such as beryl,¹⁰ emerald,¹¹ and other transparent stones, by coloring crystal, one questions the means of doing this, and thinks at once of the numerous, colored glass imitations.¹² The passage from Propertius (*S. I*),¹³ "For what now . . . should clear crystal adorn my hands?" might possibly come under the glass gems. Quintus Curtius Rufus (*S. I*),¹⁴ in recording a Persian custom, writes, "The likeness of the sun, enclosed in a crystal, shown forth above the tent, whence it could be seen by all." It has been suggested that this was a golden ball enclosed in rock crystal.¹⁵ The difficulty of enclosing anything in crystal and the comparative ease of doing it with glass is self-evident.¹⁶ But the use of *crystallum* which most strikingly suggests glass is its employment, by metonymy, for a vessel of crystal. Among these numerous references¹⁷ two are of particular interest because they refer to Egypt, the great glass center. Lucan (*S. I*) writes, "And a *crystallos* provides the waters of the Nile for their hands."¹⁸ Among the many passages in which Martial (*S. I*) uses *crystalla*, occurs the following: "While the cargo from the Nile is

¹⁰ *N. H.* 37, 79: Indi et alias quidem gemmas crystallum tinguendo adulterare invenerunt, sed praecipue berullos.

¹¹ *Id.* 37, 197: quin immo etiam extant commentarii auctorum—quos non equidem demonstrabo—, quibus modis ex crystallo smaragdum tinguant alias translucens, sardonichem e sarda, item ceteras ex alijs; neque enim est ulla fraus vitae lucrosior.

¹² See below, p. 144ff.

¹³ 4, 3, 52 (51): nam mihi quo . . . | crystallusque meas ornet aquosa manus?

¹⁴ 3, 3, 8: patrio more Persarum traditum est orto sole demum procedere. die iam inlusti signum e tabernaculo regis bucina dabitur; super tabernaculum, unde ab omnibus conspici posset, imago solis crystallo inclusa fulgebat.

¹⁵ Vögel (1885), *ad loc.*

¹⁶ See above, p. 55.

¹⁷ The following references might easily indicate glass: *Copa*, 30: seu vis crystalli ferre novos calices. *Stat.* see below, p. 88, n. 20. *Mart.* 8, 77, 5: candida nigrescant vetulo crystalla Falerno. 9, 22, 7: nec labris nisi magna meis crystalla terantur. 9, 73, 5: rumpis et ardenti madidus crystalla Falerno. 10, 66, 5: quis potius cyathos aut quis crystalla tenebit. 10, 13, 5: candida Setini rumpant crystalla trientes. *Apul. Met.* 2, 19: ibi crystallum impunctum. 6, 13: sic aiens crystallo dedolatum vasculum insuper ei graviora, tradidit. *Sidon. Epist.* 2, 13, 7: spumarent Falerno gemmae capaces inque crystallis calerent unguenta glacialibus.

¹⁸ *Bell. Civil.* 10, 160: manibusque ministrat Niliacas crystallos aquas.

bringing you *crystalla*, accept some cups from the Flaminian Circus."¹⁹

The adjective *crystallinus*, -a, -um, means 'like crystal'²⁰ as well as 'of crystal.' It is impossible to tell whether the crystalline pieces for draughts mentioned by Petronius (*S.* 1)²¹ were of crystal or of glass, as in some other instances.²² But, when Pliny speaks of a crystalline *pila*, 'ball,' being used as a cauterizing agent,²³ one feels pretty sure that it is the same as the *vitrea pila*²⁴ mentioned elsewhere by him. In his description of crystal, he also speaks of a crystalline *trulla*, 'ladle,' and *calices*, 'cups.'²⁵ Fortunatus (*S.* 6) mentions a crystalline *poculum*, 'cup.'²⁶ Of course, transparent glass was most like crystal, and the question again arises whether the above objects, modified by a form of the adjective, or the neuter of the adjective used substantively, especially in the plural form *crystallina*, are exclusively of crystal or of glass, or sometimes of one, sometimes of the other. *Crystallina*, and *murrina*, the former probably standing for crystal glass vessels, and the latter, for colored, opaque glass vessels, are forms of expression repeatedly used by Roman writers. From the frequent references to crystalline and murrine vessels²⁷ and from the use of *crystallum* alone, one learns that some of these vessels came from Egypt,²⁸ that they were fragile, expensive, and sometimes clearly of glass. Seneca (*S.* 1) writes, "I see crystalline vessels, whose fragility enhances their value; for among the ignorant the desire for possessing things increases with the danger of losing them."²⁹ In his essay *On Wrath*

¹⁹ 12, 74, 1: dum tibi Niliacus portat crystalla catapulus|accipe de circo pocula Flaminio.

²⁰ For example, Plin. *N. H.* 37, 144: alectorias vocant in ventriculis gallinaceorum inventas crystallina specie. Drac. 8, 75: crystallina Xanthi fluminis unda rubet. Venant. Fortunat. *Carm.* 11, 26, 9: fluminibus mediis nata est crystallina ripa.

²¹ 33: sequebatur puer cum tabula terebinthina et crystallinis tesseris, notavique rerum omnium delicatissimam. pro calculis enim albis ac nigris aureos argenteosque habebat denarios.

²² See below, p. 183, E.

²³ See above, n. 3.

²⁴ See below, p. 159, n. 62.

²⁵ See above, n. 3. Cf. below, p. 166, n. 117.

²⁶ *Vita S. Mart.* 2, 83: vix discernendis crystallina pocula potis.

²⁷ See below, p. 86ff.

²⁸ See below, p. 91, n. 35. Cf. notes 18-19 above.

²⁹ *De Benefic.* 7, 9, 3: video istic crystallina, quorum accendit fragilitas pretium; omnium enim rerum voluptas apud inperitos ipso, quo fugari debet, periculo crescit.

he tells the story of one of the servants breaking a *crystallinum* when Vedius Pollio was entertaining Augustus. In anger the master decreed that the slave be thrown into his fish pond, but "Augustus . . . ordered that the slave should be set free, the rest of the cups broken, and the pond filled up."³⁰ On *crystallina* Martial writes, "You break crystalline vessels while afraid of doing it."³¹ It was this "unusual use and value" which caused Paulus (S. 3) to doubt³² whether they should be classed as household goods.^{32a} Among the numerous references to crystalline vessels in Martial³³ is one which clearly shows that these particular *crystallina*, at least, were of glass: "And having complained that the crystalline vessels were spoiled by a little common glass, he marked and set aside ten murrines."³⁴ Here the crystalline glasses clearly contained impurities in spots. This passage, while showing that crystalline vessels could mean glass vessels, makes us wonder whether *crystallina* were not frequently made of glass.

D. *Murra* (*Murrha*, *Myrra*, *Myrrha*)

The origin and meaning of the Greek *morria* and the Latin *murra* have long been subjects of speculation. A discussion of the words in a history of glass is imperative, if for no other reason, at least because Pliny mentions a glass imitation of *murrina*.¹ Whenever the source of supply of murrine vessels is mentioned in ancient authors, it is always an eastern one: Egypt, Parthia, Carmania, and numerous

³⁰ *De Ira*, 3, 40: ut possis iram comminuere, quemadmodum fecit divus Augustus, cum cenaret apud Vedium Pollionem. fregerat unus ex servis eius crustallinum; rapi eum Vedius iussit ne vulgari quidem more periturum: murenis obici iubebatur, quas ingentis in piscina continebat . . . motus est novitate crudelitatis Caesar et illum quidem mitti, crustallina autem omnia coram se frangi iussit complerique piscinam.

³¹ I, 111: crystallina: frangere dum metuis, franges crystallina: peccant | securae nimum sollicitaeque manus.

³² See below, p. 92, n. 46.

^{32a} Paul. *Sent.* 3, 6, 67: supellectile legata capsae et armaria, nisi quae solum librorum aut vestis ponendae gratia paratae sint, debentur; sed et buxina et cristallina et argentea et vitrea vasa, tam escaria quam pocularia, et vestis stratoria legato cedunt.

³³ I, 53, 6: sic Arretinae violant crystallina testae. See below, p. 91ff., and above, n. 17, 19.

³⁴ 9, 59, 14: et turbata brevi questus crystallina vitro | murrina signavit deposuitque decem.

¹ *N. H.* 36, 198: fit et album et murrina aut hyacinthos sappirosque imitatum. et omnibus aliis coloribus, neque est alia nunc sequacior materia aut etiam picturae accommodatior.

localities not specified; hence it is natural to look in that direction for the origin of the words *morria* and *murra*. Laufer² refers to the Persian “*mori, muri, or muris*, meaning ‘small shells’ or ‘glass beads’” as a probable survival of *mura* or *murra* which he believes existed in an Iranian language, and conjectures that the Greek *morria* “is an Iranian loan-word and that the Iranian prototype had the significance ‘glass paste, glaze.’ ” The Latin *murra* (*murrha, myrra, myrrha*) and its adjective derivatives *murreus* (*murrheus, myrreus, myrrheus*) and *murrinus* (*murrhinus, myrrinus, myrrhinus*), sometimes confused with *murra*, from the Greek *murra*, ‘myrrh,’ are closely connected with the Greek *morria* and its adjective *morrinos* (*murrinos, mourrinos, morinos*), but it is impossible to tell whether the Latin word was derived from the Greek, or *vice versa*, or whether they both came from some lost word of unknown Asiatic source.

Since there are but two references to *morria* in Greek literature, little can be learned of its nature from that source. In both instances, however, it seems to be an artificial product. In the *Periplus of the Red Sea* (S. 1) it is mentioned in the adjective form with *lithia hyalê* as manufactured at Diospolis for foreign trade.⁴ Pausanias (S. 2) classes it with “glass and crystal and everything else made of stone.”⁵

² Laufer, *The Beginnings of Porcelain in China* (1917), 125. In this same section Laufer writes, “Roloff was the only one to attempt an explanation of the peculiar term by inviting attention to a Russian word, *murava*, which denotes ‘glazed pottery.’ If it can be proved that murrines were glazed pottery vessels, there is a great deal of probability in the conviction that *murra* applies to their most striking feature, the glaze.” Kisa, *op. cit.*, 2, 533, had previously made the following comment: “Der Hinweis auf den russischen Namen *Murava* für glasierte Waren hat keinen Sinn, denn dieser bedeutet nichts anders als Moravia, Mähren und diente ursprünglich wohl zur Bezeichnung des glasierten irdenen Geschirres, das in Mähren erzeugt und über Schlesien, Ungarn und Poland nach Russland verkauft wurde.”

⁴ 6: *προχωρεῖ δ' εἰς τοὺς τόπους ἱμάτια βαρβαρικά ἄγναφα τὰ ἐν Αἰγύπτῳ γινόμενα, . . . καὶ λιθίας ὑαλῆς πλείονα γένη καὶ ἄλλης μουρρίνης, τῆς γινομένης ἐν Διοσπόλει.* Fabricius, *Der Periplus des Erythr. Meeres* (1883), 42, n. 3: “C. *μορρίνης*, Gelenius und Stuck *μορρινῆς*, Stuck Schol. p. 18 besserte, während Blancard noch *μορρίνης* und Hudson *μυρρινῆς* drucken liessen, Müller behält hier *μορρίνης*, schreibt aber ¶ 48 n. 49 richtig *μουρρίνης*.” Thiersch (*Abhandl. d. bayer. Acad.* 1 (1835), 445), 455, included the form *μόρινος*; Kisa, 532, uses the form *μορρίνος*; Laufer, *l. c.*, the form *murrinos*.

⁵ 8, 18, 5: *ὑαλος μὲν γε καὶ κρύσταλλος καὶ μόρρια καὶ ὅσα ἐστὶν ἀνθρώποις ἄλλα λίθου ποιούμενα, καὶ τῶν σκευῶν τὰ κεραμεῖα, τὰ μὲν ὑπὸ τῆς Στυγὸς τοῦ ὕδατος ῥήγνυται.* Hitzig-Blümner, 3, 1 (1907) n. 5: “*μορρία* edd. ante s. v. b. Lab. Pa, *μόρια* Pc, *μυρρία* Camerar. Palm. MS., *μόρρα* Salm. exerc. Plin. p. 203 sq., *μούρρινα* malit K, *μόρρια* cett. edd. codd., *μόρρινα*? Vit. VIII, 3.” Thiersch, *l. c.* and Kisa, *l. c.* use the form *morra*; Laufer, *l. c.* the form *morriion*.

In Latin literature the word *murra* appears oftener, especially in connection with the *vasa murrina*, but very few authors give any suggestion of its nature. Propertius (*S. I*)⁶ is the first to mention the substance in speaking of "murrine cups *cocta* in Parthian *focis*." The translation of *cocta* and *focis* depends upon the interpretation of the substance here dealt with. At least almost⁷ all are agreed that the cups are an artificial product in the composition of which fire has played a large part. In a number of passages, some of which are extremely puzzling, Pliny (*S. I*) gives our only detailed account of *murrina*, but makes no mention of *murra* itself. He says, "The East sends *murrina*; they are found there in many places, not particularly noted, chiefly in Parthia; but the best ones are found in Carmania. Their moisture is believed to be solidified by subterranean heat. In size they never exceed a small tray; in thickness they are seldom as large as the cups mentioned above. Their brightness is not great, and it is more nearly a lustre than a brilliancy. But highly esteemed is the variety of colors with the spots one after the other turning into purple and white and a mixture of the two, with the purple, by a change of color, becoming flame-colored, or the milky white becoming red. Some praise particularly their edges and certain reflection of the colors, such as those seen in the rainbow. Again, others are pleased by opaque spots—translucency, or pallor, is a defect—and also crystals and warts, not projecting, but for the most part depressed, as in the human body. There is also some recommendation in their odor."⁸ He goes on to

⁶ 4, 5, 26: seu quae palmiferae mittunt venalia Thebae | murreaque in Parthis pocula cocta focis.

⁷ Contrary to the general opinion, Rothstein, *Die Elegien des S. Prop.* (1898), *ad loc.*, quotes Plin. 37, 21, and adds: "Nur diesen vermeintlichen unterirdischen Prozess kann Properz mit den Worten *in . . . cocta* meinen." Butler, *S. Prop. Opera Omnia* (1905), *ad loc.*: "It may refer (1) to the natural subterranean process mentioned by Pliny, or (2) Propertius may have been misinformed, and regarded the material as manufactured by the hand of man and subjected to a firing process. The latter view is, I think, more probable."

⁸ *N. H.* 1, 37: quando primum myrrhina invecta. luxuria circa ea (7). natura eorum (8). 37, 21-22: oriens myrrhina* mittit. inveniuntur ibi pluribus locis nec insignibus, maxime Parthici regni, praecipua tamen in Carmania. umorem sub terra putant calore densari. amplitudine numquam parvos excedunt abacos, crassitudine raro quanta dicta sunt potiora. splendor est iis sine viribus nitorque verius quam splendor. sed in pretio varietas colorum subinde circumagentibus se maculis in purpuram candoremque et tertium ex utroque, ignescente veluti per transitum coloris purpura aut rubescente lacteo. sunt qui maxime in iis laudent extremitates et quosdam colorum percussus, quales in caelesti arcu spectantur. iam alii

say that "the cause which produces crystal is exactly opposite to this."⁹ Elsewhere Pliny mentions the subterranean source of *murrina*: "We dig *murrina* and *crystallina* from the same earth, the fragility of which increases their value;"¹⁰ and, again, "Of things found on top of the earth crystals are the most valuable, of those within, adamant, emeralds, gems, *murrina*."¹¹ He classes *murrina* with gems, probably as of the same rank in appearance and value, yet not as gems, in the following instances also. In decrying stones as the leading folly of the time, he adds, "to say nothing of gems and amber, crystalline, and murrine objects."¹² And referring to the substances just mentioned, Pliny later states that "all of these enjoy the same importance as gems; the two former for certain good reasons: *crystallina* because adapted for cold drinks, *murrina* for both."¹³ The introduction of this luxury into Rome is ascribed to Pompey, as a consequence of his extensive conquests in the East. "This same conquest first introduced *murrina* into the city; and Pompey first dedicated murrine bowls and cups from this triumph to Jupiter Capitolinus. Next they passed over into private use; besides trays and eating utensils were in demand. This luxury is daily increasing. A large cup of exactly three pints was purchased for 70,000 sesterces (*ca.* \$3,150) . . . -anus of consular rank who drank from it, because of his love for it gnawed its edge, an injury, however, which increases its value; and today there is no other murrine vessel that will be valued more highly. It is possible to estimate how much this same man consumed in other things of this kind, from their number, which was so great that, when Nero deprived his children of them and exhibited them, they filled a special theatre in the gardens across the Tiber, which was large enough for the crowd

maculae pingues placent—tralucere quicquam aut pallere vitium est—itemque sales verrucaeque non eminentes, sed, ut in corpore etiam, plerumque sessiles. aliqua et in odore commendatio est. *myrrina a. murrina S.—nam (amu-F) Fl Ven.

⁹ N. H. 37, 23: contraria huic causa crystallum facit, gelu vehementiore concreto.

¹⁰ N. H. 33, 5: murrina* ex eadem tellure et crystallina effodimus, quibus pretium faceret ipsa fragilitas. *murrinae B'VRd.

¹¹ N. H. 37, 204: extra tellurem crystallis, intra adamanti, smaragdis, gemmis, myrrinis.* *murrinis S.

¹² N. H. 36, 1: lapidum natura restat, hoc est praecipua morum insania, etiam ut gemmae cum sucinis atque crystallinis murrinisque sileantur.

¹³ N. H. 37, 30: eandemque omnia haec quam gemmae auctoritatem; sane priora illa aliquis de causis, crystallina frigido potu, myrrhina* utroque. 37, 49: myrrhinorum et crystallinorum diximus gratiam. *murrina S.

that filled it when Nero performed, before he gave his entertainments in the theatre of Pompey. At that time I saw numbered the broken fragments of a single goblet which it seemed proper to keep in an urn for display, as if it had been the body of Alexander the Great, I suppose, to arouse the grief of the age and reveal the envy of Fortune. Titus Petronius a consular, when about to die, from envy of Nero, so as to deprive him of his table service, broke a murrine ladle which had cost 300,000 sesterces (*ca.* \$13,500). But Nero, as was proper for an emperor, surpassed all by buying a single bowl for 1,000,000 sesterces (*ca.* \$45,000); a fact to be remembered, namely, that the emperor and the father of his country drank from such a costly vessel."¹⁴ The new luxury was not accepted for a time into the religious ceremonies. "At the present time even in the midst of this wealth the first libation at the sacrifices is not from murrine or crystalline, but from earthen ladles."¹⁵ Vitellius ordered a dish, which equaled Nero's bowl in price. A special furnace had to be erected for its preparation, and Pliny regarded it as excessive luxury "that even earthen vessels cost more than murrines."¹⁶

It is difficult to say just what Pliny meant by *murrina*. Although he mentions only *murrina*, he speaks of them at times as if they were

¹⁴ *N. H.* 37, 18-20: eadem victoria primum in urbem myrrhina* invexit, primusque Pompeius capides et pocula ex eo triumpho Capitolino Iovi dicavit, quae protinus ad hominum usum transiere, abacis etiam escariisque vasis expetitis; et crescit in dies eius luxuria. myrrhino** LXX HS empto, capaci plane ad sextarios tres calice, potavit . . . anus consularis, ob amorem adroso margine eius, ut tamen inuria illa pretium augeret; neque est hodie myrrhini*** alterius praestantior indicatura. idem in reliquis generis eius quantum voraverit, licet aestimare ex multitudine, quae tanta fuit, ut auferente liberis eius Nerone exposita occuparent theatrum peculiare trans Tiberim in hortis, quod a populo impleri canente se, dum Pompeiano proludit, etiam Neroni satis erat. vidi tunc adnumerari unius scyphi fracti membra, quae in dolorem, credo, saeculi invidiamque Fortunae tamquam Alexandri Magni corpus in conditorio servari, ut ostentarentur, placebat. T. Petronius consularis moriturus invidia Neronis, ut mensam eius exheredaret, trullam myrrhinam**** HS CCC emptam fregit; sed Nero, ut par erat principem, vicit omnes HS | X | capidem unam parando. memoranda res tanti imperatorem patremque patriae bibisse! *murrh-dhv. murr-(Ven.)S. murina F.-nam L. om. a. **murrino La(Ven.)S. murino F. ***murrini La(Ven.)S. murini F.²-nae F.¹ ****myrrhinam J.-na B. murrinam La(Ven.)S. marinam F.

¹⁵ *N. H.* 35, 158: in sacris quidem etiam inter has opes hodie non murrinis crystallinisve, sed fictilibus prolibatur simpulis.

¹⁶ *N. H.* 35, 163: at, Hercules, Vitellius in principatu suo | X | HS condidit patinam, cui faciendae fornax in campis exaedificata erat, quoniam eo pervenit luxuria, ut etiam fictilia pluris constant quam murrina.* *murina R. unina V.

a mineral substance mined from the earth.^{16a} It does not seem probable that he referred to excavation of buried cups.¹⁷ He seems to imply a natural product, formed within the earth, as the source of these cups,^{17a} although it is conceivable that he figuratively refers to materials from which the vessels were made by an artificial process involving heat.¹⁸ It is probable that he has given us confused accounts of something which he has heard but of which he did not have first-hand knowledge. At least, we can learn from Pliny's account that murrine vessels were imported from the East, that they were a luxury, at times classed with gems, that they were spotted, colored, and fragile, and that at one stage in the preparation the material was fired in a furnace (therein agreeing with Propertius).

Since Propertius and Pliny do not mention *murra*, it might be well to see how it is used by other authors. *Murra* (*murrha*, *myrrha*, *myrrha*) occurs frequently in Latin literature, but, with few exceptions, it refers to the amber or yellowish brown gum resin, prized for its odor and medical properties, or to the tree from which this resin comes. When *murra* is used in the sense of the Greek *morria*, which was mentioned above in the category of glass and crystal, it refers to the material from which a cup was made or stands by metonymy for the cup itself. As a matter of fact, in order of occurrence, the second use comes first. Lucan (*S.* 1), in contrasting the few necessities of a soldier with the demands of luxury, says, "not from gold nor *murra* do they drink."¹⁹ Statius (*S.* 1) writes, "In a hand fairer than crystal he carries to the great leader the first cups, both heavy *murrae* and *crystalla*."²⁰ Martial (*S.* 1) mentions these vessels in the following passages. "Ponticus, you drink from *murra*."^{20a} "If you drink warm wine, a *murra* is suitable for hot Falerian, and the flavor of the wine is improved by it."²¹ A glass cup

^{16a} Thiersch, *op. cit.* 460.

¹⁷ This possibility, however, is suggested by Kisa, *op. cit.*, 541, and by Laufer, *op. cit.*, 132.

^{17a} Thiersch, *loc. cit.*

¹⁸ Laufer, *loc. cit.*

¹⁹ *De Bello Civil.* 4, 380 (378): non erigit aegros | nobilis ignoto diffusus consule Bacchus, | non auro murræque bibunt, sed gurgite puro | vita redit. See *Adnotationes*, below n. 24.

²⁰ *Silv.* 3, 4, 58 (57): hic pocula magno | prima duci murrasque graves crystal-laque portat | candidiore manu.

^{20a} 4, 85, 1: tu *murra*, Pontice.

²¹ 14, 113: *murrina*. si caldum potas, ardenti *murra* Falerno | convenit et melior fit sapor inde mero.

would certainly add nothing to the flavor of wine, although there might have been some notion then that it did. There was obviously some confusion between *murra*, 'myrrh,' and *murra*, 'a murrine vessel,' or between *murrina*, 'a fragrant wine,'²² and *murrina*, 'murrine vessels.' Very likely an accidental homophony contributed to the fancy that murrine vessels actually had an odor, as suggested by Pliny,²³ or a flavor, as Martial here indicates, for the Ancients were notoriously addicted to strange notions about stones, like those regarding the amethyst, the sarcophagus, and many another. The author of the *Adnotationes super Lucanum* had the absurd idea that *murra* here was a kind of fragrant wood, thinking, no doubt, of the tree which produced the well known ointment.²⁴ One may fairly suppose, I presume, that *murrina* were no longer common at the time when these scholia were written, or, at least, that they no longer bore this designation. Unfortunately nothing very definite seems to be known about the age of the *Adnotationes*.

In the two instances in which *murra* is mentioned as the material from which cups were made, a slight idea of its appearance is gained. Martial described Eros as weeping whenever he gazes upon cups of spotted *murra*, because he cannot buy up all the shops.²⁵ A scholiast on Juvenal (*S.* 4) explains *murrina* as "colored cups made of *murra*."²⁶ From the use of *murra*, then, it is impossible to tell whether it was a natural or artificial product. It is called colored and spotted, just as in Pliny's description; good for warm wine, while Pliny suggests that it is good for both hot and cold; it means also the material from which the murrine cups were made, or by metonymy, the cups themselves.

The adjective *murreus* (*murrheus*, *myrreus*, *myrrheus*), 'of myrrh,' 'yellowish,' 'of *murra*,' in the latter sense, is applied to cups and vessels for eating and drinking. Propertius' account of

²² Plin. *N. H.* 14, 92: *lautissima apud priscos vina erant murra odore condita. Thes. Gloss.* 4, 257, 33: *potio divina.*

²³ See above, n. 8.

²⁴ *Ad* 4, 380: *gemmaque legitur et murrave* . . . murra genus ligni, quod dat odores, ut Virgilius 'murrache madentis.' hic ergo 'murrum' poculi genus accipimus de hoc ligno facti, et quod dixit 'non murra, non auro,' aureum poculum intellegimus. *mura W, (murraque) vel gemma U.*

²⁵ 10, 80, 1: *plorat Eros, quotiens maculosae pocula murræ | inspicit aut pueros nobilium citrum, | et gemitus imo ducit de pectore, quod non | tota miser coëmat Saepa feratque domum.*

²⁶ *Ad* 6, 156 (ed. Jahn (1851)): *myrrhina D. Adanans. de murra pacual sincta (facta).*

the making of murrine cups has been discussed above. If his *murreus onyx*²⁷ could be shown to be a 'murrine onyx' rather than 'a yellow onyx,' as it has been interpreted by most scholars, probably following Pliny's description of *onyx*^{27a} or the definition of *murreus* given by Porphyrio,²⁸ it might throw some light on the nature of *murra*. Seneca (*S.* 1) evidently considered it a natural product, for he classed it among gems in the following quotation: "I see murrine cups; of course, luxury would be far too cheap unless . . . they drank each others health in hollowed gems."²⁹ Again, he says, 'Whether it is a gold cup, or a crystalline, or a murrine, or a Tiburtine goblet, or a hollow hand, it makes no difference.'³⁰ Yet, the Digest, although seemingly in some doubt, says that murrines are not to be classed as gems, and classifies among household goods murrine and glass vessels employed for food and drink.³¹

The adjective *murrinus*, 'made of *murra*,' occurs more frequently than *murra* or *murreus*, especially in the substantive form *murrina*, 'murrine vessels.' As an adjective it is applied to *calices*, 'cups,' *trulla*, 'a ladle,' *vasa*, 'vessels,' and *pocula*, 'cups.' The first two instances were noticed in Pliny. As mentioned above, the Digest does not class murrine vessels as gems.³² Theonas (*S.* 3)³³ speaks of murrine *vasa* for food and drink. Suetonius (*S.* 2)³⁴ says that when Augustus took Alexandria, he kept nothing for himself except one murrine *calix*, 'cup.' Capitolinus (*S.* 4) in the history of Verus tells of *calices* of *murra* or Alexandrian crystal being presented at a ban-

²⁷ 3, 10, 22: et crocino naris murreus unguat onyx.

^{27a} *N. H.* 36, 61: probantur quam maxime mellei coloris, in vertices maculosi atque non translucidi.

²⁸ *Ad Hor. Carm.* 3, 14, 22: murreum nodo cohibere crinem colorem murreum in crinibus hodieque dicunt, qui medius est inter flavum et nigrum.

²⁹ *De Benefic.* 7, 9, 3: video murrea pocula; parum scilicet luxuria magno fuerit, nisi, quod vomant, capacibus gemmis inter se propinaverint.

³⁰ *Epist.* 119, 3: utrum sit aureum poculum an crystallinum an murreum an Tiburtinus calix an manus concava, nihil refert.

³¹ *Javol. Dig.* 33, 10, 11: murrhea autem vasa, et vitrea, quae ad usum edendi et bibendi causa parata essent, in supellectili dicuntur esse.

³² *Ulpian, Dig.* 34, 2, 19, 19: murrhina autem vasa in gemmis non esse, Cassius scribit.

³³ *Epist.* 6 (*Patr. Gr.* 10, 1572 D): simili modo ille agat cuius fidei credita sunt vasa argentea, aurea, crystallina, vel murrhina, escaria vel potoria.

³⁴ *Aug.* 71: item lautitiarum invidiam, cum et Alexandria capta nihil sibi praeter unum murrinum* calicem ex instrumento regio retinuerit et mox vasa aurea assiduissimi usus conflaverit omnia. *myrr- vel myrrh-codd.

quet to each guest for each drink.³⁵ He, as well as other authors, records Marcus Aurelius' sale of the royal *pocula*, 'cups.'³⁶

Pliny, as we have seen above, is the only one who has made a conscious effort to describe *murrina*, 'murrine vessels.' When he specifies the type of vessel, it is a *capis*, 'a bowl with one handle,' a *poculum*, 'cup,' an *abacus*, 'tray,' *escaria vasa*, 'dishes,' or a *scyphus*, 'goblet.' Seneca³⁷ mentions murrine along with crystalline vessels. Martial speaks of these vessels in a number of passages, the translation of which will give an adequate conception of the circumstances of their employment. "You alone have golden and murrine vessels."³⁸ "He gives the arrant fools Opimian nectar in crystallines and murrines."³⁹ "He marked and set aside ten murrine vessels."⁴⁰ "If you are out after money, sell your silverware, tables, murrines, your estate, and house."⁴¹ "Do you drink Surrentine? Choose for it neither colored murrines nor gold."⁴² *Murrina* are also described under *murra*.⁴³ Juvenal (*S.* 1/2) says, "Heavy crystalline and still heavier murrine vessels are carried away."⁴⁴ In another Satire he writes, "Tongilius weighs down his Thracian

³⁵ 5, 3: donatos etiam calices singulis per singulas potiones, myrrinos et crystallinos Alexandrinos, quoties bibitum est.

³⁶ *M. Ant.* 17, 4: cum autem ad hoc bellum omne aerarium exhausisset suum neque in animum induceret, ut extra ordinem provincialibus aliquid imperaret, in foro divi Traiani auctionem ornamentorum imperialium fecit vendiditque aurea pocula et cristallina et murrina, vasa etiam regia et vestem uxori sericam et auratam, gemmas quin etiam, quas multas in repostorio sanctiore Hadriani reppererat. Aurel. Victor, *de Caesar.* 16, 9: instrumentum regii cultus facta in foro Traiani sectione distraxit, vasa aurea, pocula crystallina et murrina . . . ac per duos continuos menses venditio habita est multumque auri redactum. Eutrop. *Breviarium ab Urbe Condita*, 8, 13, 2, is the same as the above from *instrumentum* through *murrina*, except that *Divi* stands before *Traiani*.

³⁷ *Epist.* 123, 7: omnes iam mulos habent, qui crustallina et murrina et caelata magnorum manu portant.

³⁸ 3, 26, 2: aurea solus habes, murrina solus habes.

³⁹ 3, 82, 25 (24): Opimianum morionibus nectar | crystallinisque murrinisque propinat.

⁴⁰ 9, 59, 14: murrina signavit seposuitque decem.

⁴¹ 11, 70, 8 (7): si te delectat numerata pecunia, vende | argentum, mensas, murrina, rura, domum.

⁴² 13, 110: Surrentina bibis? nec murrina picta nec aurum | sume: dabunt calices haec tibi vina suos.

⁴³ See above, n. 21.

⁴⁴ 6, 156 (153): mense quidem brumae, quo iam mercator Iaso | clausus, et armatis obstat casa candida nautis, | grandia tolluntur crystallina, maxima rursus | myrrhina, deinde adamans notissimus et Berenices | in digito factus pretiosior.

slaves with the long poles of his litter as he goes through the Forum to buy slaves, silverware, murrines, villas."⁴⁵ Although, in the Digest, Javolus (*S.* 1) had said murrine vessels should not be classed as gems, and Ulpian (*S.* 3) had classed them as household goods, Paulus (*S.* 3)⁴⁶ suggests that one might doubt whether they should be so classed, "on account of their uncommon use and value." In discussing the follies of Elagabalus, Lampridius (*S.* 4)⁴⁷ speaks of *murrina* along with onyx vessels, which might possibly be taken as a slight indication that the two materials bore a marked resemblance. Sidonius Apollinaris (*S.* 5)⁴⁸ mentions *murrina* with a number of precious stones. Although Isidore (*S.* 6/7) is only following Pliny,⁴⁹ he varies from the original by using *murrina* as a noun in the singular number.⁵⁰ His use of *murrina*, as well as that by Pliny and Sidonius Apollinaris, would almost lead one to think that it indicated the material from which vessels were made, as well as the vessels themselves. Under Pliny's account of *murrina* we have the only detailed description, however imperfect that may be. Elsewhere the vessels are again called *picta*, 'colored.' Their uncommon use and value are emphasized to the extent that the Law is uncertain whether they should be classed as household goods. In several instances they are classed with or as gems.

After examining the Greek *morria*, the Latin *murra*, and their derivatives, one feels that the Ancients themselves were unfamiliar with the exact nature of the vessels, of foreign origin, which they mention so frequently as objects of luxury. At least, nobody since the time of Pliny has been able to explain his description of *murrina* to everyone's satisfaction. The diverse views of scholars

⁴⁵ 7, 133 (129): exitus hic est | Tongilli, magno cum rhinocerote lavari | qui solet et vexat lutulenta balnea turba | perque forum iuvenes longo premit assere Maedos, | empturus pueros, argentum, murrina, villas.

⁴⁶ 33, 10, 3, 4: de murrhinis et cristallinis dubitari potest, an debeant adnumerari suppellectili, propter eximium usum et pretium; sed et de his idem dicendum est.

⁴⁷ *Heliog.* 32, 2: naves onustas mersit in portum, magnanimitatis hoc esse dicens. onus ventris auro excepit, in myrrinis et onychis minxit.

⁴⁸ *Carm.* 11, 21 (20): potes chrysolithi fulvus diffulгурat ardor; myrrhina, sardoniches, amethystus Hiberus, iaspis | Indus, chalcidicus, Scythicus, beryllus, achates | attollunt duplices argenti cardine valvas.

⁴⁹ See above, n. 8.

⁵⁰ *Orig.* 16, 12, 6: murrina apud Parthos gignitur, sed praecipua in Carmania. humorem sub terra putant calore densatum; unde et nomen sumpsit. varietas eius in purpuram candoremque et ignem cum quosdam colorum repercussus, quales in caelesti arcu spectantur. cuius contraria causa crystallum facit, gelu vehementiori concreto.

since the sixteenth century have been discussed by others,⁵¹ and only a list of their conjectures need be given here: namely, porcelain, stone, shell, amber, meerschaum, onyx, sardonyx, carneol, alabaster, agate, fluor-spar, jade, chalcedony, gum, obsidian, Chinese soapstone, glass, and pottery.⁵² The fact that true porcelain was not yet in existence at the time in question discredits one of the earliest and most persistent of the conjectures.^{52a} Pliny's account and the mention of *murrina* along with and as gems would naturally lead to efforts to identify it with a precious or semi-precious stone, which could easily be imitated. Among later authors Blümner⁵³ partially clings to its mineral origin. There seems to be a tendency among recent investigators of the subject, however, to discredit the natural origin of *murra*, and to consider it solely as an artificial product. And, indeed, there is no passage where *murra* must have been a natural product. Pliny is the only author who seems to imply such an origin, but he is speaking of *murrina* and not of *murra*, which may show that he was not actually familiar with the composition of the vessels.

The two most recent investigators rightly maintain that Pliny's description does not answer to any natural product, but they do not agree on the nature of the material. Kisa believes that there were "no murrines except glass ones,"⁵⁴ and shows, to the satisfaction of some,⁵⁵ that the only murrines which have been preserved, at least, are an artificial glass product, namely the *millefiori* or glass-mosaic.⁵⁶ Laufer⁵⁷ considers this stand untenable because Pliny also speaks of a glass imitation, which he would not have

⁵¹ Roloff, *Ueber die murrinischen Gefässe der Alten* (*Mus. der Alterthumswissenschaft*, 2 (1808), 515ff.); Thiersch, *op. cit.* 443ff.; Walz, *Murrina Vasa* (Pauly's *Real-Encyclopädie* (1848)); Becker, *Gallus*, 2 (1880), 385ff.; Marquardt, *Röm. Privatalt.* (1882), 744ff.; Kisa, *op. cit.* 2, 532ff.; Laufer, *op. cit.* 121ff.

⁵² This list is taken from Thiersch, *op. cit.* 448, and Laufer, *op. cit.* 121, 123, 129.

^{52a} *Ibid.* 123.

⁵³ *Tech. u. Term.* 3, 276.

⁵⁴ *Op. cit.* 2, 551: "Ich gehe aber weiter und glaube, dass es überhaupt keine anderen als gläserne Murrinen gegeben hat, und dass es ein müssiges Unterfangen ist, nach irgend einem Edel- oder Halbedelstein oder einem anderen Stoffe zu forschen, der die hochgeschätzten Prachtgefässe des Altertumes geliefert hat."

⁵⁵ Dillon, *Glass* (1907), 50, would look for imitations among the millefiori glasses. Richter, *Bulletin of the Metrop. Mus. in N. Y.* 14 (1919), 173ff., agrees with Kisa. A. de Ridder, *Rev. d. Et. Grec.* 33 (1920), 373.

⁵⁶ *Op. cit.* 552ff. Cf. Morin-Jean (Daremborg-Saglio, 5, 941).

⁵⁷ *Op. cit.* 134.

done if he had recognized all murrines as glass. Yet this does not prove that all murrines were *not* of glass; it simply shows that Pliny did not think that they were. Laufer also has given an excellent discussion of the subject upon the thesis that *murrina* were "highly-glazed pieces of Oriental, that is, Iranian or Persian and Egyptian, pottery."⁵⁸ When pottery and *murrina* are mentioned together,^{58a} he takes the former as "rustic, unglazed, indigenous Italic earthenware" and the latter as "the pretentious, glazed, imported Oriental pottery."⁵⁹ The fact that crystal and murrines are spoken of together so frequently Laufer believes to be due to the extreme difference in their origin, and the fact that they were imported from the same region.⁶⁰ But glass is also frequently mentioned with them, and murrines were most often referred to at the time when glass was becoming of great importance in Rome. Each of the three materials was fragile, and it is also possible that they were mentioned together because of similarity, *vitrum* standing for ordinary glass, *crystallus* for extremely clear glass, and *murra* for equally expensive, opaque, colored glass.⁶¹ But it is quite evident that the Greek and Latin authors give us insufficient material for forming more than a conjecture. However, whether one accepts either or neither of the last two theses, they are of great importance to anyone who is following the development of glaze and glass. Although all do not agree that murrines were exclusively of glass, yet inasmuch as any murrine *might* be glass, all references to these vessels will be noted under the section on the use of glass.

⁵⁸ *Ibid.* 124.

^{58a} See above, n. 15-16.

⁵⁹ *Op. cit.* 134.

⁶⁰ *Ibid.* 131, 133.

⁶¹ Kisa, *op. cit.* 544.

IV. THE MANUFACTURE OF GLASS

A. TRADITIONAL ORIGIN

By far the earliest glass known comes from Egypt,¹ where it had been manufactured for so many centuries that probably no record of its discovery remained when the Greeks began to interest themselves in the substance. At a relatively early time, however, the Phoenicians² devoted themselves to the manufacture of glass, and then with such success that the account³ which has come down from antiquity regarding its discovery, ascribes it to navigators along the Phoenician coast. The account as given by Pliny (*S.* 1)⁴ runs: "According to tradition a ship of natron⁵ merchants came to shore and when the men were scattered all along the beach preparing the meal, since there were no stones to support their kettles, they put pieces of natron from the ship under them. When these

¹ Appert, *Note sur les Verres des Vitraux Anciens* (1896), 3; Walters, *Hist. of Anc. Pottery*, 1 (1905), 8; Bissing, *Sur L' Hist. du Verre en Égypte* (*Rev. Archéol.* Sér. 4, 11 (1908), 211); *Id.* (*Records of the Past*, 8 (1909), 57); Frank (*Class. Philol.* 13 (1918), 158); Newberry, *A Glass Chalice of Tuthmosis III* (*Jour. of Egypt. Archaeol.* 6 (1920), 156, 159).

² Dillon, *op. cit.* 23; Nesbitt-Powell, *Glass* (*The Encyclopaedia Britannica*, ed. 11, 12 (1910), 98).

³ Another tradition is mentioned without the name of the ancient authority by Palissy, *Oeuvres Complètes* (ed. of 1844), 156: "Aucuns disent que les enfans d'Israël ayant mis le feu en quelque boys, le feu fut si grand qu'il eschauffa le nitre avec le sable jusques à le faire couler et distiler le long des montagnes et que deslors on chercha l'invention de faire artificiellement ce qui avoit esté fait par accident, pour faire les verres." Sauzay, *La Verrerie* (1869), 3, and Hondt, *L'Art de la Verrerie* (1893), 13, quote this passage from Palissy; the former, as well as Mrs. Dunlop, *op. cit.* 62, and Kisa, *op. cit.* 97, ascribe this to Josephus. Eisen (*Intern. Stud.* 77 (1923), 392): "Josephus, however, gives to his own race, the Jewish, credit for the discovery, asserting that it was observed that glass had been formed in the sand by a forest fire—an improbable although not an impossible source of the art." None of these authors cites the passage where this incident is related, and since I have been unable to find such a statement in Josephus, I doubt its authenticity.

⁴ *N. H.* I, 65: origo vitri. 36, 191: (190: pars Syriae, quae Phoenice vocatur . . .) fama est adpulsa nave mercatorum nitri, cum sparsi per litus epulas pararent nec esset cortinis attollendis lapidum occasio, glaebas nitri e nave subdidisse, quibus accensis, permixta harena litoris, tralucentes novi liquoris fluxisse rivos, et hanc fuisse originem vitri. Cf. *Isid. Orig.* 16, 2; Rabanus Maurus, *de Universo*, 17, 10; Heraclius, 3, 5.

⁵ On the use of natron, Dillon, *op. cit.* 41ff.

had caught on fire and the sand of the shore mixed with them, there flowed transparent streams of a new substance, and this was the origin of glass." Although Pliny records this story as a tradition, some attempt has been made to rationalize it;⁶ however, scientists, in general, seem to be agreed that it is technically impossible.⁷

B. MATERIALS

The chief materials mentioned in the composition of ancient glass are silicates and alkalis. Sand, the silicate usually employed, was also regarded as the principal ingredient.¹ Its use was known to

⁶ Pellatt, *Curiosities of Glass Making* (1849), 1: "Of such imperfect vitrification, the 'glass' occasionally dug up on the sites of buildings destroyed by great conflagrations is a specimen." Cf. Daubrée (*Rev. Archéol.* n.s. 41 (1881), 18-28), reviewed in *Rev. de Philol.* 6 (1882), 239, 243 by Thédénat. Froehner, *op. cit.* 2f.: "Pour moi, l'erreur de Plin est tout entière dans sa dernière phrase: 'telle fut l'origine du verre'; s'il avait dit: 'telle fut l'origine de la fabrication du verre au moyen du sel de nitre,' on n'aurait plus aucune objection à hasarder. Les peuples qui ont connu le verre avant les Phéniciens, n'employaient, comme fondant, que la potasse, c'est-à-dire un alcali végétal, obtenu au moyen de la combustion de certaines plantes. La Phénicie eut le mérite de remplacer ces sondes imparfaites par l'alcali minéral, le fondant par excellence et sans lequel il est impossible de fabriquer des verres transparents." The latter part of this statement is very properly, it would seem, objected to by Friedrich (*Rhein. Jahrb.* 74 (1882), 168). On a similar incident with silver in Mexico, see Wendell Phillips, *The Lost Arts* (1891), 366-367. Powell, *Glass-making in Eng.* (1923), 5: "His (Pliny's) attribution of the discovery to certain Phoenician merchants shipwrecked on the coast of Syria, near the mouth of the river Belus, may be inaccurate, but the development of a durable glass from the deliquescent silicate of soda, which the merchants found mixed with the ashes of their camp fires, is precisely and scientifically traced. If, as Pliny states, the cooking pots were supported on blocks of natron (impure carbonate of soda) the heat of the fire would bring about the combination of soda with the seashore sand, and the glass-like substance, silicate of soda, would be formed. Experience must soon have shown that sand and soda, alone, could not produce a stable, workable glass."

⁷ Burty, *Chefs-d' Oeuvre of the Industrial Arts* (1869), 177; Gerspach, *L' Art de a Verrerie* (1885), 12; Blümner, *Tech. u. Term.* 4, 380, 1; Morin-Jean (*Darmstadt-Saggio*, 5 (1912), 936).

¹ Plin. *N. H.* 36, 200: accipit harenas, ex quibus aliubi vitrum fundit. See above, p. 95, n. 4. Galen, 12, 185: κατὰ δὲ τὸν αὐτὸν τρόπον ἢ (γῆ) τὴν ὕαλον ἔχουσα ψάμμιός ἐστιν, ἐν ψάμμῳ γὰρ μάλιστα τῆς τοιαύτης οὐσίας εὐρίσκεται ψήγματα πολλάκις μικρά. καὶ ὅσοι τούτων ἔμπειροι θεασάμενοι τὰς τοιαύτας ψάμμους γνωρίζουσιν ὅποσον ἐξ αὐτῶν ἀθροῖσαι δύνανται τῆς ὕαλον . . . ἀλλ' οὐκ ἐξ ἀπάσης ψάμμου τὸν χρυσὸν ἐξαίρουσι καὶ τὴν ὕαλον οἱ περὶ ταῦτ' ἔχοντες . . . διὰ τοῦτο μὲν οὖν καίτοι γε πολλὰς ψάμμοις χρυσοῦ καὶ ὕαλου ψηγμάτων περιεχομένων οὐκ ἐπὶ πάσας οἱ περὶ ταῦτα δεινοὶ παραγίνονται. Euseb. (*Patr. Gr.* 24, 1142 A): vidit enim cogitatus in sabulo vitrum. intuerere ergo quantum distat cogitatus in corpore. quid videt oculus? sabulum; quid videt sensus? vitrum. intueris alium et alium: ille enim videt sabulum iste autem videt vitrum, quod necdum est. . . .

the Greeks before the process of manufacture became very familiar, for Theophrastus (*S.* IV/III)² writes, "And if glass too is made from vitreous earth, as some say, this also is produced by compression." The nature of the sand determined the manufacturing centers and the kind of glass produced. The most noted source of supply was the sand of the Belus river³ (modern Nahr Na 'mên)⁴ in southern Phoenicia. Pliny says, "The part of Syria, which is called Phoenicia, bordering upon Judea, has within the spurs of Mount Carmel a swamp, which is called Candebia. It is thought that the Belus river rises from this and after a distance of five miles flows into the sea near the colony of Ptolemais. It is sluggish, unwholesome to drink, but held sacred for certain ceremonies, slimy, deep, and it does not show its sands except at ebb tide, which, agitated by the waves, are cleansed from impurities. Then too they are believed to be cleansed by the acidity of the sea water; otherwise they are not useful. The length of the shore is not more than half a mile, and this was sufficient for making glass during many centuries." Among the references to the sands of the Belus mentioned above, the account by Josephus (*S.* 1) is of interest: "This Ptolemais is a maritime city of Galilee, built in the great plain. . . . The very small

(C): ex sabulo fructum vitri. Phoebadius, *de Fide Orthodoxa*, 8 (*Patr. Gr.* 20, 46 A): ut arena, cum mutatur in vitrum. Theodoret. (*Patr. Gr.* 83, 617 A), see below, p. 151, n. 3. *Aen. Gaz.* 552, see below, p. 104, n. 28. *Excerpta ex Commentar. Alexandri et Olympiodori* (Ideler, 29): τήκεσθαι δέ φησι καὶ πηλὸν καὶ γῆν δῆλον, τὴν ἔχουσαν ἐν αὐτῇ ὑγρότης, ὅποιά ἐστιν, ἐξ ἧς ὕελος γίνεται.

² *De Lap.* 49: εἰ δὲ καὶ ὁ ὕελος ἐκ τῆς ὑελίτιδος ὥς τινὲς φασι, καὶ αὕτη πυκνῶσει γίνεται.

³ Plin. *N. H.* 5, 75: iuxta Getta, Geba, rivus Pacida sive Belus, vitri fertiles harenas parvo litore miscens. 36, 190f.: pars Syriae, quae Phoenice vocatur, finitima Iudaeae intra montis Carmeli radices paludem habet, quae vocatur Candebia, ex ea creditur nasci Belus amnis quinque milium passuum spatio in mare perfluens iuxta Ptolemaidem coloniam. lentus hic cursu, insaluber potu, sed caerimoniis sacer, limosus, vado profundus, non nisi refuso mari harenas fatetur; fluctibus enim volutatae nitescent detritis sordibus. tunc et marino creduntur adstringi morsu, non prius utiles. quingentorum est passuum non amplius litoris spatium, idque tantum multa per saecula gignendo fuit vitro. Cf. Isid. *Etym.* 16, 16, 1. Tac. *Hist.* 5, 7: et Belius amnis Iudaico mari inlabitur circa cuius os lectae harenae admixto nitro in vitrum excoquuntur. Joseph. *Bell. Iud.* 2, 10, 2: κυκλωτερῆς μὲν γὰρ ἐστὶν καὶ κοῖλος, ἀναδίδωσιν δὲ τὴν ὑελίνην ψάμμον, ἣν ὅταν ἐκκενώσῃ πολλὰ πλοῖα προσσχόντα, πάλιν ἀντιπληροῦνται τὸ χωρίον, κατασυρόντων μὲν ὥσπερ ἐπίτηδες τότε τῶν ἀνέμων εἰς αὐτὸ τὴν ἔξωθεν ἀργὴν ψάμμον, τοῦ δὲ μετάλλου πᾶσαν εὐθὺς μεταβάλλοντος εἰς ὕελον. θαυμασιώτερον [δὲ] τούτου μοι δοκεῖ τὸ τὴν ὑπερχυθεῖσαν ὕελον ἐκ τοῦ τόπου πάλιν ψάμμον γίνεσθαι εἰκαίαν.

⁴ Benziger, *P.-W.* s. v. *Belos*.

river Belaeus runs by it, at the distance of two furlongs from the city, near which is Memnon's monument, which has near it a remarkable place no larger than one hundred cubits. This is round and hollow, and yields such sand as glass is made of, and when this sand has been emptied by the many ships loaded there, the place is filled again by the winds, which sweep into it, as if on purpose, sand that lay remote, and was common sand, which this mine turns at once entirely into glass (*sic*). And what seems to me still more wonderful, the glass (*sic*) which once leaves the place becomes common sand again. Such is the nature of the place we are speaking of."⁵ Besides this sand, according to Strabo (*S. I.*), "There are those who say that the Sidonians also have vitreous sand suitable for melting."⁶ According to his report, the glass workers of Alexandria considered their costly, colored glass dependent upon the sands of Egypt.⁷ Turning from the great eastern manufacturing centers, Pliny mentions the white sand of the river Volturnus, for six miles between Cumae and Liternum, as suitable for making glass.⁸ Gaul and Spain also seem to have had local sources of supply.⁹ But the use of crystal in India to produce an unparalleled quality of glass¹⁰ is doubtful. Crystal was more valuable than glass, and, as Friedrich observes, it is not probable that it was destroyed to make a less valuable product.¹¹ However, the broken pieces, chips, and fragments might have been so used. Yet even so, or if a kind of quartz were meant by crystal, it would still be uncertain whether in antiquity glass was ever manufactured in India.¹²

⁵ See above, n. 3. Translation—Whiston's, revised by Shilleto.

⁶ 16, 758: μεταξὺ δὲ τῆς Ἀκῆς καὶ Τύρου θινώδης αἰγιαλὸς ἐστὶν ὃ φέρων τὴν ὑαλτὶν ἄμμον· ἐνταῦθα μὲν οὖν φασι μὴ χεῖσθαι, κομισθεῖσαν εἰς Σιδόνα δὲ τὴν χωνεῖαν δέχεσθαι· τινὲς δὲ καὶ τοῖς Σιδωνίοις εἶναι τὴν ὑαλτὶν ψάμμον ἐπιτηδείαν εἰς χύσιν, οἱ δὲ πᾶσαν πανταχοῦ χεῖσθαι φασιν. Cf. Eustath. *Comm.* on Dionys. Periegetes, 912: λέγεται δὲ καὶ ψάμμος ὑαλτίτις εἶναι τοῖς Σιδωνίοις ἐπιτηδεία εἰς χύσιν.

⁷ 16, 756: ἤκουσα δ' ἐν τῇ Ἀλεξανδρείᾳ παρὰ τῶν ὑαλουργῶν, εἶναι τινα καὶ κατ' Αἴγυπτον ὑαλτὶν γῆν, ἧς χωρὶς οὐχ οἶόν τε τὰς πολυχρούους καὶ πολυτελεῖς κατασκευὰς ἀποτελεσθῆναι, καθάπερ καὶ ἄλλων μιγμάτων δεῖν.

⁸ *N. H.* 36, 194, see below, p. 102, n. 4.

⁹ *Idem.*

¹⁰ *N. H.* 36, 192: auctores sunt in India et crystallo fracta fieri et ob id nullum comparari Indico.

¹¹ *Rhein. Jahrb.* 74 (1882), 173, where he suggests a clear quartz is meant instead of crystal.

¹² Wallace-Dunlop, *op. cit.*, 106: "Sir G. Birdwood has suggested that when Pliny speaks of Indian glass . . . he probably meant Chinese; a confusion very

The alkali most frequently mentioned is *nitrum*,¹³ a natural soda of some kind,¹⁴ found plentifully in Egypt.¹⁵ Without doubt, the ashes of certain plants and woods were also used in antiquity, although they are not mentioned by classical authors.¹⁶ However, a scholiast on Aristophanes' *Clouds* says, "We call *hyalos* that which has just been burned from a certain herb and melted by fire for the preparation of certain vessels."¹⁷ Later, Theophilus (*S.* 11/12)¹⁸ recommends the use of the ashes of beech-wood, and Heraclius¹⁹ (*S.* 9/10) also mentions the use of ashes in the preparation of glass.

Although ancient glass might be styled a soda-glass,²⁰ something besides silicates and alkalis was needed to form a stable glass. Aside from chemical analysis, the durability of ancient glass shows that other ingredients were used, but there is almost no reference to them. Probably Pliny intends to include lime when he speaks of shells and excavated sand.^{20a} After describing the traditional origin of glass, he continues: "In the process of time, as human industry is ingenious in discovering, it was not content with the combination with nitre, but magnet-stone began to be added as well; from the impression that it attracts liquid glass as well as iron. In a similar manner, too, brilliant stones of various descriptions came to be added in the

likely to be made at that time in Rome, especially as the Chinese still use quartz rock at the present day for making glass, and Royle tells us enamellers in India still use cakes of glass imported from China." Dillon, *op. cit.*, 343: "I can point to no examples of Indian glass of earlier date than the Mogul dynasty." Kisa, *op. cit.*, 1, 105ff.

¹³ Plin. *N. H.* 36, 191f.; Tac. *Hist.* 5, 7; Aen. *Gaz.* 552; Isid. *Etym.* 16, 16, 2 ff.

¹⁴ Blümner, *Tech. u. Term.* 4, 388; Powell, *op. cit.* 6.

¹⁵ Plin. *N. H.* 31, 110: in nitro optimum quod tenuissimum, et ideo spuma melior, ad aliqua tamen sordidum, tamquam ad inficiendas purpuras tincturasque omnes. magnus et vitro usus, qui dicitur suo loco. 111: nitrariae Aegypti circa Naucratis et Memphin tantum solebant esse, circa Memphin deteriores.

¹⁶ Dillon, *op. cit.* 79.

¹⁷ Schol. on Aristoph. *Nub.* 768: ἄλλως. ὕαλον ἡμεῖς μὲν ἀρτίως τὸ ἐκ βοτάνης τινὸς κεκαυμένον καὶ διὰ πυρὸς τηρόμενον εἰς κατασκευὴν ἀγγείων τινῶν λέγομεν. Salmas. *Plin. Exercit.* 771a, G f: "ex herba vitrum conficere inventum tunc locorum in Graecia tradit. quod hodie sit ex cineribus filicis exustae admixta, quam soldam vocant, conflatur vitrum sed vilius. filicarios calices vulgo vocamus. at herba illa de qua loquitur interpres Aristoph., quae exurebatur ad vitra conflanda, est herba kali. sic Arabes vocant."

¹⁸ See 2, 1. Dillon, *op. cit.* 128.

¹⁹ See 3, 7.

²⁰ Dillon, *op. cit.* 25; Newberry (*Four. of Egypt. Archaeol.* 6 (1920), 159).

^{20a} Translated by Dillon, *op. cit.* 77, as "sandy concretions."

melting, and, at last, shells and excavated sand."²¹ The identity of the *magnes lapis* has been a matter of dispute. Some have considered it to be magnetic iron ore, others oxide of manganese,²² while still others reject these proposals on the ground that such materials "can only be used in glass manufacture in comparatively small quantities for the purpose of colouring or neutralizing colour in glass, and their introduction would not be a matter of sufficient importance to be specially recorded."²³ They identify it with magnesian limestone, and state that "no better matter could have been introduced into the mixture of sand and soda to make a durable glass."²⁴ In Greek alchemical literature *magnêsia hyelourgikê* is mentioned several times.^{24a} The diversity of application of the word *magnêsia*,^{24b} is illustrated in these passages, for sometimes *magnêsia* is used to produce coloration, while at other times it is used to purify the glass. It is not until many centuries later that lead is mentioned as an ingredient.²⁵

Besides the necessary constituents other materials were introduced for the purpose of coloring the glass. Although there are repeated references to colored glass and the imitation of gems, there is little indication among earlier writers of what materials were used

²¹ *N. H.* 36, 192: *mox, ut est ingeniosa sollertia, non fuit contenta nitrum miscuisse; coeptus addi et magnes lapis, quoniam in se liquorem vitri quoque ut ferrum trahere creditur. simili modo et calculi splendentes multifariam coepti uri, dein conchae ac fossiles harenae.* See *N. H.* 34, 148: *hic lapis et in Cantabria nascitur, non ut ille magnes verus caute continua, sed sparsa bulbatione—ita appellant,—nescio an vitro* fundendo perinde utilis, nondum enim expertus est quisquam. *vitro B cfr. 36, 192 ultro (-ra a) ll. d a h v.*

²² *Plin. N. H.* 36, 126f.; *Dillon, op. cit.* 77; *Laufer, op. cit.* 106, n. 3.

²³ *Nesbitt-Powell, op. cit.* 12, 98.

²⁴ *Powell, op. cit.* 6. Cf. *Nesbitt-Powell, loc cit.*

^{24a} *Berthelot, Collection*, 38, 3: ἄλλως περὶ κυμβαράεως.—δεῖ γινώσκειν ὅτι ἡ μαγνησία ἢ ὑελουργικὴ ταύτη ἐστὶν ἡ τῆς Ἀσίας, δι' ἧς ὁ ὕελος τὰς βαφὰς δέχεται, καὶ ὁ Ἰνδικὸς σίδηρος γίνεταί, καὶ τὰ θαυμάσια ξίφη. *Idem*, 305, *Chemistry of Moses*, 27: οἰκονομία τῆς θειοτάτης μαγνησίας.—ἀλλὰ καὶ ὕελον μαλάσσει, ὥστε καὶ λευκαίνεισθαι αὐτὸν ποιεῖ. *Idem*, 293, note 1: "Ceci pourrait s'appliquer à l'oxyde de manganèse, *Introd.*, p. 256." *Idem.*, 307 (34): νίτρον πυρρὸν ὃ ἐστὶν ῥίθειον, ἄλλας καμπηδοκικόν, μαγνησίας λευκῆς, ἀφροσέληνον ὕαλου, κυανός, τίτανος ὀπτῇ. *Idem*, 347, 1: βάφη τοῦ Ἰνδικοῦ σιδήρου. . . .—καὶ μαγνησίας ὑελουργικῆς ἀνωτέρας θηλυκῆς μὲν β'. Note 4: "Oxyde de fer ou de manganèse." *Idem*, 383, 2: χρυσοῦ ποίησις.—καὶ ἡ μαγνησία τῶν ὑελίνων.

^{24b} See *Idem*, 221ff.; 255ff.; *Hist.* 2, 18, 5; 2, 194, 165.

²⁵ *Heraclius*, 3, 8; *Theophilus*, 2, 31; *Dillon, op. cit.* 130, 131, 148. On the use of oxide of lead, see *Layard, Discoveries among the Ruins of Nineveh and Babylon* (1853), 672; *Henrivaux (Ency. Chim.* 13 (1883), 1).

to produce the different colors. The use of dark substances, such as the Alabandicus stone,²⁶ might possibly produce a dark glass; however, the nature of the stone is a matter of dispute.²⁷ Copper was definitely used for coloring.²⁸ In late writers, such as Heraclius and Theophilus, detailed accounts of the coloring of glass may be found.

For mending broken glass both calcium oxide²⁹ and white of egg³⁰ and sulphur³¹ were suggested by ancient authors. Theophilus devotes the thirtieth chapter of his second book to a later method.

C. METHODS

The art of making glass, the *hyalourgikê technê*,¹ was one of great antiquity and importance, yet classical writers give us slight information concerning it. This paucity of information has been

²⁶ Plin. *N. H.* 36, 62: e diverso niger est Alabandicus terrae suae nomine, quamquam et Mileti nascens, ad purpuram tamen magis aspectu declinante. idem liquatur igni funditurque ad usum vitri.

²⁷ Nies, *P.-W. s. v. Alabandicus*.

²⁸ Theophr. *de Lap.* 49: ιδιωτάτη ἡ τῷ χαλκῷ μίγνυμένη· πρὸς γὰρ τῷ τήκεσθαι καὶ μίγνυσθαι καὶ δύναμιν ἔχει περιττὴν ὥστε τῷ κάλλει τῆς χροᾶς ποιεῖν διαφορὰν. Plin. *N. H.* 36, 193: levibus autem aridisque lignis coquitur addito cyprio ac nitro, maxime Aegyptio. Cf. Isid. *Etym.* 16, 16, 3; Rabanus, *de Universo*, 17, 10. Dillon, *op. cit.* 26: "Everything points to the predominance of copper as a colouring material at an early period, so much so that we may perhaps consider—and this is a suggestion that has indeed been already made by a French writer—that the invention of glazes in the first place, and then that of glass, were offshoots of the metallurgy of copper, and that these industries may therefore be especially connected with the copper age."

²⁹ Mellor, *A Comprehensive Treatise on Inorganic and Theoretical Chemistry*, 3 (1923), 653: "The calcium oxide obtained by calcining calcium carbonate has been variously styled *quicklime*, *burnt lime*, *caustic lime*—from *καυστικός*, burnt—*live lime*, etc."

³⁰ Plin. *N. H.* 29, 51: et, ne quid desit ovorum gratiae, candidum ex iis admixtum calci v¹vae glutinat vitri fragmenta. *Corp. Med. Lat.* 4, 284, 11: album ovi cum calce mixtum vitrea vasa solidat.

³¹ *Id.* 36, 199: vitrum sulphuri concoctum feruminatur in lapidem. Iuv. 5, 48: calicem . . . quassatum et rupto poscentem sulpura vitro. Schol. Vet. (Iuv. *Sat. ed.* Heinrich (1839)) on 5, 48: *quassatum et rupto*: ut solent sulfure calices fractos sive calvariolas componere. *sulfura*: quia hoc solent vitrum solidare, id est, maltare. There is also the possibility that the cup is so worthless that it is ready to be traded for sulphur, for there seems to have been a practice of trading broken glass for sulphur; compare Mart. 1, 41; Stat. *Silv.* 1, 6, 74.

¹ David, *Proleg. et in Porphy. Isagogen*, 20, 11ff.: οἶον ὡς ἐπὶ τῆς ὑαλουργικῆς· ἐὰν γὰρ εἴπωμεν ὅτι ὑαλουργικὴ ἐστὶ τέχνη περὶ ὕαλον καταγινόμενη, τέλειός ἐστιν ὅρος· εἴ τι μὲν γὰρ ὑαλουργικὴ ἐστὶ, τοῦτο τέχνη περὶ ὕαλον καταγινόμενη, καὶ εἴ τι περὶ ὕαλον. καταγινόμενη, τοῦτο τέχνη ἐστὶν ὑαλουργικὴ· τῇ γὰρ ὑαλουργικῇ μόνῃ ὑποκεῖται ὁ ὕαλος. Nicephorus Blemmida (*Patr. Gr.* 142, 697): ὑαλουργικὴ ἐστὶ τέχνη καταγινόμενη περὶ τὴν ὕαλον. See above, p. 51.

explained on the ground that the art was not developed in Greece, and the Roman writers had no Greek source upon which to rely for a description of glassmaking.² Pliny, our chief source, briefly describes the method employed in Sidon,³ "the ancient method of making glass," and continues with the method used in his own day in Italy, Spain, and Gaul.⁴ But he does not give us in either of the passages, which seem to be put together from different sources, a definite formula for the ingredients, a picture of the glass furnace, or a detailed description of the processes. In the foregoing section we have noted the employment of sand, natron, magnet-stone, and shells under the older method. In his own day he says that the sand was made as fine as possible and then mixed with three parts of soda.⁶ Theophilus⁷ gives the proportion of one part of sand to two of ashes. After the ingredients had been thoroughly mixed, they were put into a glass oven.

Unfortunately we have little information concerning the glass oven, the Greek *kaminos hyelourgikê*,⁸ the Latin *fornax*;⁹ or the glass-

² Dillon, *op. cit.* 49.

³ *N. H.* 36, 193 (continuing after p. 100 n. 21, and p. 101, n. 28, above): *continuis fornacibus ut aes liquatur, massaeque fiunt colore pingui nigricantes. acies tanta est quacumque, ut citra sensum ullum ad ossa consecet quidquid adflaverit corporis. ex massis rursus funditur in officinis tinguiturque, et aliud flatu figuratur, aliud torno teritur, aliud argenti modo caelatur, Sidone quondam his officinis nobili, siquidem etiam specula excogitaverat.*

⁴ *Ibid.* 194: *haec fuit antiqua ratio vitri. iam vero et in Volturmo amne Italiae harena alba nascens sex milium passuum litore inter Cumas atque Liternum, qua mollissima est, pila molave teritur. dein miscetur III partibus nitri pondere vel mensura ac liquata in alias fornaces transfunditur. ibi fit massa, quae vocatur hammonitrum, atque haec recoquitur et fit vitrum purum ac massa vitri candidi. iam vero et per Gallias Hispaniasque simili modo harena temperatur. Cf. Isid. *Orig.* 16, 16; Rabanus Maurus, *de Universo*, 17, 10.*

⁶ See above, n. 4. One would naturally expect that three parts equalled three-fourths (Harper's *Lex. s. v. pars*, II, G), but this proportion of sand and soda, although it can be fused, does not make glass (see Gelstharp and Parkinson, *The Limits of Proportions of Soda-Lime Glasses in Tr. Am. Cer. Soc.* 16 (1914), 109ff.). Dillon, *op. cit.* 79, thinks it probably means three parts in twelve or ten, twenty-five or thirty per cent of the whole. Froehner, *La Verrerie*, 27, takes this passage to mean three parts of soda to nine of sand, basing his opinion on the theory that the duodecimal system was used. This sounds extremely attractive in view of the fact that it makes a possible proportion of sand and alkali, but in no place have I been able to find *pars* used as one twelfth.

⁷ 2, 4. According to Berthelot, *Hist.* 2, 194, 165, a Syriac alchemical manuscript mentions ten parts of alkali and three of sand.

⁸ *Georgr.* 20, 16: *κριοῦ τὸ μύριον βαλὼν εἰς ὀρόβιον ὦμόν, καὶ ἄλλο ὀρόβιον ἐπικαλύψας πύλησον, ὥστε μὴ ἔχειν ἀνάπνοιαν μηδαμόθεν, καὶ δὸς εἰς κάμινον*

factory, the Greek *hyalourgeion*,¹⁰ the Latin *vitraryum*.^{10a} Dioscorides (*S. I*) says that "the soot which the painters use is taken from the places where glass is made."¹¹ The poor people seem to have gone to the glass-factories to get warm.¹² A fantastic story is told of a boy who was thrown into an oven by his father but miraculously rescued.¹³ The alchemist often used a *kaminos hyelourgikê* or one similar to it.^{13a} None of these references, however, give any idea of the construction of the oven. But in the works of Theophilus¹⁴ and Heraclius¹⁵ there are elaborate descriptions of the different ovens for cooking, cooling, and reheating.¹⁶ A contemporary drawing of a glass furnace in a manuscript of 1023, at Monte Cassino, of Rabanus Maurus' *De Originibus Rerum* has been reported.¹⁷ The illustrations in Agricola's *De Re Metallica*¹⁸ give a good idea of early modern furnaces and utensils. Petrie gives illustrations of fritting pans and glass in different stages of preparation, in an excellent description of the process of manufacture, based on archaeological finds in Tell el Amarna.^{18a}

υελουργικὴν ὀπτηθῆναι ἀπὸ πρωῒ ἕως ἑσπέρας, καὶ εὐρήσεις αὐτὸ μαλακὸν γεγενὸς, ὡς τυρόν. See above, p. 21, n. 12. Berthelot, *Collection*, 36, 4: Συνάξεος τῶν φιλοσόφων.—καὶ πάλιν βάλλε τὸν αὐτὸν λίθον, καὶ τῶν σαρκῶν τῶν σαριχευτικῶν καὶ θὲς εἰς κάμινον υελουργικὴν ἰσχυράν· καὶ λάμβανε τὸ ἐπάνω τοῦ λίθου, καὶ ὁ λίθος μένει κρύσταλλος. Zos. II (*Coll.* 246): ἔχουσιν οὖν φύσιν αὐται αἱ βαφαὶ καὶ πολλὰ σήπτεσθαι, καὶ ὀλίγα, τουτέστιν γίνεσθαι καὶ ἐν καμινίοις υελοψοῖς. *Chemistry of Moses*, 38 (*Collection*, 307): καὶ περιπηλώσας τὴν χύτραν, θὲς ἐν καμίνῳ υελουργικῇ. *Idem*, 40 (308): λέγκωσις μαγνησίας.—ἐὰν δὲ ἔστιν μέλαινα, καῦσον ἕως ἀναλευκανθῆ, κάλλιον δὲ ἔστι εἰς κάμινον ὀπτᾶν αὐτὴν υελουργικὴν. *Collection*, 383: κινναβάρεως σκευασία.—καὶ ποιήσον καμίνιον οἶον τοῦ υελοψοῦ. *Idem*, 341, 10: δὸς καμίνῳ υελουργικῷ. See also 349, 1; *Hist.* I, 181; 2, 172 ff.

⁹ See above, n. 3, and below, n. 39. The alchemist mentions the *fornax*, *Lib. Sac.* 175: feci hoc in fornace vitreorum. . . . in fornace ubi ponuntur vitri. 182: coque in fornace vitri desuper.

¹⁰ See above, p. 50f.

^{10a} See above, p. 65, 1.

¹¹ 5, 181: ἀσβόλη, ἣ ζωγράφοι χρῶνται, λαμβάνεται μὲν ἐκ τῶν υελουργείων. Cf. Paul. Aeg. 7, 3.

¹² Leont. *Vita S. Symeon. Sali* (*Patr. Gr.* 93, 1736 D): ἦν δὲ πάλιν ἅπαξ καθήμενος μετὰ ἀδελφῶν, καὶ θερμαινόμενος πλησίον τοῦ καμινίου τοῦ υελέψου.

¹³ See below, p. 113, n. 5.

^{13a} See above, n. 8-9.

¹⁴ 2, 1ff., 22.

¹⁵ 3, 7ff.

¹⁶ According to Dillon, *op. cit.* 127: "A German writer (A. Friedrich, *Alt-Deutsche Gläser*) has illustrated the furnaces of Theophilus by means of a diagram, and attempts to show how they differ from those described by the pseudo-Heraclius."

¹⁷ *Ibid.* 125.

¹⁸ 12 ((1657), pp. 471, 473, 474, 476).

^{18a} (1894), 25-27, pl. XIII; *The Arts and Crafts of Anc. Egypt.* (1909), 125-127.

The available supply of fuel, no doubt, influenced the location of glass factories. And the kind of fuel used was of great importance for the production of the proper degree of heat.^{18b} Pliny says that the wood should be light and dry.¹⁹ Both tamarisk²⁰ and papyrus²¹ are mentioned as suitable for the purpose.

As soon as the mixture of sand and soda began to get hot, it was stirred so that it would not liquify and congeal immediately.²² There were windows in the glass-ovens, through which the workmen could carry on such operations.²³ But as soon as it did liquify, it was transferred to other ovens where it was allowed to form a mass called *ammonitrum*, i. e. sand-natron. This was reheated until there resulted a pure, transparent glass,²⁴ or a colored glass, in case there were impurities in the ingredients, or some material or materials had been added for that purpose.²⁵ According to Strabo,²⁶ in his day many new processes were being invented at Rome "for coloring and for simplifying the manufacture" of glass.

Unfortunately, for us, Pliny²⁷ thought best to omit the numerous formulae for coloring glass, which were known at his time. This reticence may indicate that glass was colored not only to bring on the market a product cheaper than the more expensive substance, which it might closely resemble, but also to deceive for illegal gain, or to use in magic. With the growth of magic and alchemy, it is natural that the remarkable difference between the product glass and its ingredients should be made use of. In the fifth century Aeneas of Gaza²⁸ writes, "There is nothing incredible about the

^{18b} Manget, *Bibl. Chem.* 1, 281: "Ignis, sunt octo gradus . . . 8. Ignis est qui fundit et calcinat, et est flammalis, quia in ea sola flamma operatur, et non dissipat, sicut est ignis vitrearius."

¹⁹ See above, n. 28, p. 101.

²⁰ Plut. *Quaest. Conv.* 3, 19, 3, 658 D: πρὸς δὲ τὴν τοῦ ὕλου μάλαξιν καὶ τύπωσιν εἰάρμοστον εἶναι δοκεῖ τὸ μυρικίνον. Macrob. 7, 16, 23: qui vitro soluendo formandoque curant de arbore cui myricae nomen est igni suo escam ministrant.

²¹ Cass. Felix. *de Med.* 20: papyrus vitriarorum carnosum, id est quod non fuerit fragile vel flacidum. Olympiod. on Arist. *Meteor.* 2, 228: ὅθεν πολλὴ φροντίς παρὰ τοῖς ὑελέφαις τοῦ τινάσσειν τὴν πάπυρον, i. e. so that a salamander would not fall on the fire and put it out.

²² Theophil. 2, 4.

²³ Heracl. 3, 7.

²⁴ See above, n. 4.

²⁵ See above, n. 3, and p. 101, n. 28.

²⁶ See above, p. 55, n. 13.

²⁷ See above, p. 81, 11.

²⁸ 552: καὶ ἡ ψάμμος διεσκέδασται καὶ τὸ λίτρον διακέχυται· ἀλλ' ἀνθρωπεία τέχνη καὶνὴν τινα καὶ διαφανὴ τὴν ὕαλον ἐκ τούτων ἐπενόησε.

metamorphosis of matter into a superior state. In this manner those versed in the art of matter take silver and tin, change their appearance, and transmute them into excellent gold. Glass is manufactured from divisible sand and dissoluble natron, and thus becomes a novel and brilliant thing."²⁹ Berthelot believes that before the Christian era there existed in Egypt, the home of alchemy, numerous technical recipes, including those on the manufacture and coloration of glass. Because of the relationship between alchemy and magic, some of the recipes may have been destroyed when Diocletian attempted to stamp out Egyptian magic.³⁰ At least, we have few references to the making and coloring of glass in the Greek Papyri.^{30a} However, the alchemical manuscripts probably preserve some of these early Egyptian formulae. Berthelot has not only discussed in great detail the fabrication and coloration of glass by the alchemist but he has also collected, translated, and published many of the Greek, Latin, Syriac, and Arabic alchemical manuscripts.^{30b} The most extensive references to glass among the Greek manuscripts in his collection are found in some little treatises called *Poiësis krystallôn*, 'Fabrication of little glass gems,'³¹ and *Katabhê lithôn kai smaragdôn kai lychnitôn kai hyakinthôn*, 'Coloration of stones, emeralds, red gems, and hyacinths.'^{31a} There are other references to the fabrication of glass and the coloration of gems in works ascribed to Moses, Zosimus (*S.* 4), Salmanas (*S.* 8), and in anonymous writings.^{31b} Pseudo-Democritus (*S.* 4) also wrote on coloring gems, a spurious work, ascribed to the great philosopher, which in some early form, at least, seems to have been known as early as the time of Seneca.³² Dillon^{32a} mentions a Venetian manu-

²⁹ Translation by Laufer, *op. cit.* 142.

³⁰ *Introduction*, 200 ff.; *Les Origines*, 29; 75.

^{30a} According to Hammer-Jensen, *P.-W.* Suppl. 3 (1918), 465, the *Papyrus Holmiensis* (ca. 300 A.D.) "is the only written source for knowledge of the ancient technique of coloring glass." See below, n. 42^a. Berthelot, *Les Origines*, 30; *Hist.* 2, XXV ff.

^{30b} Anyone who is interested in a study of alchemy and glassmaking is referred to the six books by Berthelot mentioned in the bibliography. These are all excellently indexed for glass.

³¹ Berthelot, *Collection*, 348-350.

^{31a} *Idem.*, 350-363.

^{31b} *Idem.*, 36, 37, 175, 305, 307, 364, 366, 368. See above, n. 8-9; p. 100, n. 24a.

³² Seneca, *Epist.* 90, 33: excidit porro vobis eundem Democritum invenisse . . . quemadmodum decoctus calculus in zmaragdum converteretur, qua hodieque coctura inventi lapides in hoc utiles colorantur. Democritus had written a work on

script which lists fifty-two such works. Attention should be called to practical formulae in Latin, such as the sections on coloring glass in the *Compositiones ad Tingenda Musiva*^{32b} in a manuscript of the eighth century, and the *Mappae Clavicula* of a century or two later, of whose section on glass all that remains is the heading: "on unbreakable glass, on the soldering of glass, on the art of tracing trees and fruits of all kinds upon a flask, on an indelible manner of painting on glass, and finally three sections on the fabrication of pearls."^{32c} The *Liber Sacerdotum* (S. 10)^{32d} contains numerous formulae for coloring glass. A new text with translation of the Greek and Latin alchemists' recipes and practical formulae for making and coloring glass, as well as Heraclius and Theophilus, is being prepared for publication.

Sometimes the preliminary mixing and fusing of ingredients was, no doubt, unnecessary, for there is indication that glass makers bought up old glass and made new glass by melting it. Pliny³ informs us that "when broken, too, glass admits of being joined by the agency of heat; but it cannot be wholly fused without being pulverized into small fragments, as we see done in the process of making the small checquers, known as 'abaculi,' for mosaic work; some of which are of variegated colors, and of different shapes. If glassis fused with sulphur, it will become hard as stone." The pictures which we have of the venders show that the trade was strongly developed at Rome in the first century after Christ. Martial³⁴ says in his epigram on Caecilius, "You are just like the tramping hawker from beyond the Tiber who exchanges pale sulphur

color. Diog. Laert. 19, 46: *περί χροῶν*. Berthelot *Hist.* 2, IX, 29, 32, 33, 36, 76, 81, 95, 284; *Introduction*, 202, 271; *Les Origines*, 93, 244. On Pseudo-Democritus in General, see Christ-Schmid, *Griech. Literaturgesch.* 6, 1074.

^{32a} *Op. cit.* 120 f.

^{32b} The text occurs in Muratori, *Antiquitates Italicae Medii Aevi*, 2 (1739), 366ff., and A. Pellizzari, *I trattati attorno le arti figurative in Italia*, Naples (1915), 379ff., 459ff.

^{32c} Berthelot, *Hist.*, 26 ff.; Dillon, *loc. cit.*

^{32d} 104, 112-116, 125-135, 149, 189, 204.

³³ *N.H.* 36, 199: fragmenta temporata adglutinantur tantum, rursus tota fundi non queunt praeter quam abruptas sibimet in guttas, veluti cum calculi fiunt, quos quidam ab oculis appellant, aliquos et pluribus modis versicolores. See above, p. 101, n. 31. Translation by Bostock and Riley.

³⁴ 1, 41: transtiberinus ambulator, | qui pallentia sulphurata fractis | permutat vitreis. Translation by Walter. See above, p. 101, n. 31.

matches for broken glass." And Statius³⁵ in describing the emperor's carnival mentions those "whose trade is to barter their cheap sulphur for scraps of glass." To be sure, there is a possibility that 'broken glass' has a figurative meaning here as in Petronius,³⁶ but in view of the fact that a thief in the time of Gregory of Tours thought it worth while to melt and sell the glass from church windows which he had stolen,³⁷ it is certain that there was a demand for old glass.

Whatever preliminary process was followed, after proper tempering³⁸ the glass was ready for fashioning into objects.³⁹ At first everything was formed by hand, and the discovery of blowing glass, not long before the beginning of the Christian era,⁴⁰ must have brought about a great change both in the number and variety of vessels produced.⁴¹ In some instances the glass was worked upon the lathe, in others it was elaborately carved like silver.⁴² There was a belief that goat's blood softened glass suitably for carving.^{42a}

³⁵ *Silv.* I, 6, 74: hic plebs scenica quique comminutis permutant vitreis gregale sulphur. Translation by Slater.

³⁶ See above, p. 77, n. 60.

³⁷ See below, p. 189, n. 17.

³⁸ *Eugraph. Comment. in Ter. Andriam*, 483: cuius rei exempla sunt vitrea vasa, quae temperata mutatione fornacum frigus assuescunt; si statim refrixerint, franguntur.

³⁹ Mesomedes, see below, p. 118, n. 26; Athen. and Theodoret., see below, p. 151.

⁴⁰ The paintings from Beni Hassan, 3800 years old, once thought to represent glass blowers (see Wilkinson, *A Popular Account of the Anc. Egyptians*, 2 (1874), 58-72) are now explained as representations of workmen blowing up a charcoal fire (see Petrie below). Dillon, *op. cit.* 44: "We know of no find of blown glass in Egypt previous to later Roman or Coptic times." Bissing, *Rev. Arch.* Ser. 4, 11 (1908), 217: "Je continue à penser que c'est dans un des ateliers phéniciens après Alexandre que fut inventé l'art de souffler le verre et que ce fut là l'origine de la tradition antique sur la priorité des verreries phéniciennes." Flinders Petrie, *Glass Blowing (Anc. Egypt.* I (1914), 33): "Thousands of pieces of glass vessels are known, about 1500-1400 B.C., yet not a single piece of blown glass is dateable before Roman times." Eisen, *The Origin of Glass Blowing (A. J. A.* Ser. 2, 20 (1916), 134): "No vessels of blown glass have been found in Egyptian tombs or excavations earlier than the Ptolemaic period." Cf. Rouillard (*Rev. de Philol.* 41 (1916), 6).

⁴¹ *Sen. Epist.* 90, 31: cuperem Posidonio aliquem vitrearium ostendere qui spiritu vitrum in habitus plurimos format, qui vix diligenti manu effingerentur. *Vopisc. Saturn.* 8, 6: alii vitrum conflant. *Pallad. Schol. on Hippocr.* 2, 222: ὁ γὰρ ὑάλαψ ἅμα τῷ φουσῶν καὶ πόρον ποιεῖ τινα καὶ σχῆμα.

⁴² See above, n. 3. *Quint. Inst.* 2, 21, 9: et caelatur, quae auro, argento, aere, ferro opera efficit. nam sculptura etiam ligna, ebur, marmor, vitrum, gemmas praeter ea quae supra dixi complectitur. *Apul. Met.* 2, 19: hic vitrum fabre sigillatum.

^{42a} *P. Holm* i. 5-7: κρυστάλλον μάλαξις. τραγείω ἅματι ζέσας μάλασσε. τὸ δὲ αὐτὸ καὶ ὑέλω. *Heraclius* 1, 4. On the fancied softening of adamant with goat's blood, see Theophylactus Simocatus, *Colloquium*, 2, 10, 1.

Carved glasses, like the Portland vase, are perfect marvels of delicacy and difficulty, and some glasses were broken by the workman in his effort to make the carving a little finer.⁴³ Many methods of fashioning glass are recorded by Heraclius and Theophilus.

D. KINDS OF GLASS

There is no definite reference in Greek literature to the earliest form of glass-making, the art of glazing. However, the silver color given to a variety of the pottery of Naucratis may have been produced in that way.¹ Glass-paste is mentioned in Homer, as has been set forth under *kyanos*.² In time the paste and the opaque, colored glass gave way to a transparent glass. The chief characteristic of *hyalos*, and later of *vitrum*, as has been shown, was transparency. The glass most highly prized was that which most closely resembled crystal. As suggested, this similarity probably led to colorless glass sometimes being called simply *krystallos* in Greek³ and *crystallum* in Latin,⁴ while objects made of it would be designated as *crystalla*, or *crystallina*.⁵ The transparent colored glass, so different from the older opaque glass, must have seemed like an entirely new substance, more nearly resembling the translucent, precious stones than the glass formerly in use. We read of different shades of blue,⁶ green,⁷ gold,⁸ opal,⁹ red,¹⁰ amethyst,¹¹ and purple,¹² black,¹³ onyx,¹⁴ and

⁴³ See below, p. 165, n. 109. Cf. p. 83, n. 31.

¹ Athen. 11, 480 D: διάφοροι δὲ κύλικες γίνονται καὶ ἐν τῇ τοῦ συσσίτου ἡμῶν Ἀθηναίου πατρίδι Ναυκράτει. εἰσὶ γὰρ φιαλῶδεις μὲν, οὐ κατὰ τὸν ὄντον δ' ἄλλ' ὥσπερ δακτύλῳ πεποιημένοι, καὶ ἔχουσιν ὄτα τέσσαρα, πυθμένα εἰς πλάτος ἐκτεταμένον, καὶ βάπτονται εἰς τὸ δοκεῖν ἀργυρεῖ. See Blümner, *Tech. u. Term.* 2, 97.

² See above, p. 11ff.

³ See above, p. 53ff.

⁴ See above, p. 79ff.

⁵ See above, p. 80ff.

⁶ See above, p. 14ff.; below, p. 146, k; Berthelot, *Collection*, 307, 349.

⁷ See above, p. 51, m; p. 70ff; below, p. 142, 4; p. 144, a; p. 145, g, h.; Berthelot, *Collection*, 349, 353: ἕλος πράσινος. 350ff. *Hist.* 1, 212, 127, 128.

⁸ See below, p. 110. Berthelot, *Hist.* 1, 207, 210. For the color of other metals, see *Idem*, 210 ff.

⁹ See below, p. 144, e; p. 177, 45.

¹⁰ See below, p. 145, f; p. 145, n. 14. *Collection*, 350.

¹¹ See below, p. 145, i; p. 149, n. 37. *Collection*, 350; *Hist.* 1, 211, 212, 223.

¹² See below, p. 157, n. 46.

¹³ See below, p. 145, j; p. 188, n. 13; Berthelot, *Hist.* 1, 211: color plumbi. 212: de nigro colore.

¹⁴ See below, p. 147, m.

yellow,^{14a} and are told that all colors were used. Nearly every kind of gem was imitated in colored glass,¹⁵ and very likely glass is sometimes understood by the name of a particular gem¹⁶ or simply by the word gem itself.¹⁷ In later times there were certain opaque glasses also which were highly prized, as the *millefiori* or glass mosaic of different colors,¹⁸ and an imitation of obsidian, the black, natural, volcanic glass, classed with glass by Pliny, and *haematinum*, a red glass.¹⁹

Aside from the different kinds of glass determined by their constituency, there are glass vessels which have special names depending upon their form and style. With the discovery of blowing, glass vessels and other hollow ware of almost every description were made. Most of these vessels had the form of earlier vessels of pottery or metal, but the names *petroti*,²⁰ *alassontes*,²¹ and *asympton*²² seem to have been applied to glass vessels alone. Some of the vessels were elaborately carved, such as Nero's Homeric cups.²³ *Toreumata*, as used by Martial,²⁴ seem to have been cups of glass carved in relief, probably like the Portland vase and the Naples amphora, although those to which he refers are not always of superior workmanship.²⁵ The *diatretra* mentioned also by Martial²⁶ are shown

^{14a} Philargyrius on *Buc.* 4, 44 (ed. Hagen (1902)), probably an Irish gloss: *croceo idest glas (MVIRCE) rubida tinctura vel purpura vel flos.* | *croceo.* i. *glas* † *tinctura* P. Berthelot, *Collection*, 349, 2: *εὐρήσεις κίτρον ὕελον, τὸ λεγόμενον βερονίκη.*

¹⁵ Plin. *N. H.* 35, 48: *admixtis vitreis gemmis.* See above p. 83, n. 1. Isid. *Orig.* 16, 3: *tinguitur etiam multis modis, ita ut iacinthos sapphiresque et virides imitetur et onyches vel aliarum gemmarum colores.* Cf. Rabanus Maurus, *de Universo*, 17, 10. *Hist.* 1, 212: *aliud quasi oleum olive.*

¹⁶ Herodotus, 2, 44. See below, p. 141, n. 27. See Rawlinson, *Herodotus*, 2, 70, 8. See below, p. 149, n. 37.

¹⁷ Verg. *Georg.* 2, 505: *hic petit excidiis urbem miserosque penatis,* | *ut gemma bibat et Sarrano dormiat ostro.* Mart. 12, 40: *gemma vis ludere, vincor.* 14, 20: *calculi | insidiosorum si ludis bella latronum,* | *gemmeus, iste tibi miles et hostis erit.* 14, 94: *nostra neque ardenti gemma feritur aqua.* See below, p. 149, n. 37.

¹⁸ See above, p. 83ff.

¹⁹ See below, p. 145, n. 14.

²⁰ See below, p. 166, no. 19.

²¹ See below, p. 172, no. 45.

²² See below, p. 176, no. 67.

²³ See below, p. 166, no. 20.

²⁴ 11, 11: *tolle, puer, calices tepidique toreumata Nili.* 12, 74: *nullum sollicitant haec, Flacce, toreumata furens,* | *et nimium calidis non vitiantur aquis.* 14, 94: *nos sumus audacis plebeia toreumata vitri.* Cf. Clem. Alex. *Paedag.* 2, 3, 35: *ναὶ μὴν καὶ τορευτῶν περίεργος ἐφ' ὕλῳ κενοδοξία εἰς θραύσιν διὰ τέχνης ἐτοιμοτέρα δεδιέναι.*

²⁵ Blümner, *op. cit.* 4, 404; Kisa, *op. cit.* 2, 590.

²⁶ 12, 70: *o quantum diatretra valent et quinque comati.*

by Ulpian in the Digest²⁷ to have been especially fragile. Such delicate work required specialized workmen, the *diatretarii*.²⁸ With the present evidence it is impossible to prove that the *diatreta* were of glass, but they, no doubt, at least included as one of their forms glass vessels²⁹ such as the network vases of Cologne.³⁰ Salmasius,^{30a} an excellent judge in such matters, clearly considered them to be of glass.

There were further means for enhancing the value of the material. The use of glass vessels decorated with gold is mentioned by Athenaeus (*S.* 2/3)³¹ in connection with the banquet of Ptolemy Philadelphus. In the church of Sancta Sophia the gold colored glass that covered the walls and ceiling was probably in the form of mosaic so common in the early churches.³² Many objects have been found, especially in the catacombs, with designs in gold between two layers of transparent glass.³³ The method of making these is described by Heraclius.³⁴ A somewhat different means of decorating with gold, ascribed to the Greeks, is given by Theophilus.³⁵

As glassmaking became a more developed art, the fragility of the substance must have been felt as a great disadvantage. Petronius (*S.* 1)³⁶ tells the story of malleable glass. "There was a workman

²⁷ 9, 2, 27, 29: si calicem diatretum faciendum dedisti, si quidem imperitia fregit, damni iniuria tenebitur: si vero non imperitia fregit, sed rimas habebat vitiosas, potest esse excusatus.

²⁸ *Cod. Theod.* 13, 4, 2; *Cod. Just.* 10, 66, 1.

²⁹ Dillon, *op. cit.* 71; Kisa, *op. cit.* 2, 624ff.; Leclercq, *Dict. d'Archéol. Chrét.* (1920), 770-772.

³⁰ Blümner, *op. cit.* 4, 400f.

^{30a} *Ad Vopisc. Saturnin.* 8: eodem plane sensu diatreta vasa vitrea, Graecis appellata sunt, quae scalpta cavataque essent. huc adde quod omnibus locis, quae caelum cavarat, quasi pertusa perforataque videbantur, translucidiore scilicet per illa visu. hinc διατρήτα dicta. caro autem vaenibant, pretium enim eorum incendeat, quod metus in eis caelands non parvus erat artificum ne frangerentur. periculum etiam aequae magnum. nam saepe operam oleumque perdebat, dum caelo vellet indulgere, et plura argumenta addere.

³¹ See below, p. 154, n. 23. See Kisa, *op. cit.* 3, 836.

³² Anon., Διήγησις περὶ τῆς Ἀγίας Σοφίας (*Script. Orig. Const.* 1, 15, 93, 6ff.): τοὺς δὲ ὀρόφους πάντας . . . κατεχρύσωσι ἐξ ὑελίνου χρυσοῦ λαμπροτάτου.

³³ Yates (*Archaeol. Jour.* 8 (1851), 170-171); Garrucci, *Vetri Ornati*, ed. 2 (1864); Le Blant (*Acad. des Inscr. et Bell. Lettres*, 15 (1888), 211); Vopel, *Die altchristl. Gold-Gläser* (1898), 1-40; Kisa, *op. cit.* 3, 867ff.; Wulff, *Altchristliche u. byzantinische Kunst*, 1 (1914), 69-70; 307-308; Leclercq, *loc. cit.*

³⁴ 1, 5.

³⁵ 2, 13-15.

³⁶ 51: fuit tamen faber qui fecit phialam vitream, quae non frangebatur. admissus ergo Caesarem est cum suo munere, deinde fecit reporrigare Caesarem

once who made an unbreakable goblet. He was admitted with his gift to the emperor's presence, then he made the emperor hand it back to him and dropped it on the floor. The emperor was in a terrible fright. But he lifted the goblet from the ground: it was dented just like a brass vessel. Next he produced a little hammer from his pocket and leisurely put the goblet all right again. After this he thought he was in the seventh heaven of good fortune, especially when the emperor asked him whether any one else knew the method of preparing this sort of glass. Now mark my words—when the workman said that no one else knew the secret, the emperor had him beheaded: for if the secret were known, we should think no more of gold than of mud.” Dio Cassius (*S.* 2)³⁷ tells a similar story of a man that had been banished as a wizard, who dropped a glass cup and mended the dent with his fingers in order to gain the emperor's favor, but he met the fate recorded by Petronius. Isidore (*S.* 6/7)³⁸ follows quite closely the story as given by Petronius. But Pliny (*S.* 1)³⁹ gives a shorter and slightly different version. “In the reign of Tiberius, it is said, a combination was devised which produced a flexible glass; but the factory of the workman was entirely destroyed to prevent the value of the metals bronze, silver, and gold from being lessened, and this story was told for a long time with more frequency than truth.” Since Pliny, who

illam in pavimentum proiecit. Caesar non pote validius quam expavit. at ille sustulit phialam de terra; collisa erat tamquam vasum aeneum; deinde martiolum de sinu protulit et phialam otio belle correxuit. hoc facto putabat se solum Jovis tenere, utique postquam Caesar illi dixit: ‘numquam alius scit hanc condituram vitreorum?’ vide modo. postquam negavit, iussit illum Caesar decollari: quia enim, si scitum esset, aurum pro luto haberemus. Translation by Lowe.

³⁷ 57, 21, 7: μετὰ δὲ ταῦτα προσελθόντος οἱ αὐτοῦ καὶ ἱκετεῖαν ποιουμένου, κἀν τούτῳ ποτήριόν τι ὑαλοῦν καταβαλόντος τε ἐξεπίτηδες καὶ θλασθέν πως ἢ συντριβέν ταῖς τε χερσὶ διατρίψαντος καὶ ἄθραυστον παραχρῆμα ἀποφήναντος, ὥς καὶ συγγνώμης διὰ τοῦτο τευξόμενον, καὶ ἀπέκτεινεν αὐτόν.

³⁸ *Orig.* 16, 16, 6: ferunt autem sub Tiberio Caesare quendam artificem excogitasse vitri temperamentum, ut flexibile esset et ductile. qui dum admissus fuisset ad Caesarem, porrexit phialam Caesari, quam ille indignatus in pavimentum proiecit. artifex autem sustulit phialam de pavimento, quae complicaverat se tamquam vas aeneum; deinde marculum de sinu protulit et phialam correxuit. hoc facto Caesar dixit artifice: ‘numquid alius scit hanc condituram vitrorum?’ postquam ille iurans negavit alterum hoc scire, iussit illum Caesar decollari, ne dum hoc cognitum fieret, aurum pro luto haberetur et omnium metallorum pretia abstraherentur; et revera, quia si vasa vitrea non frangeretur, melius essent quam aurum et argentum.

³⁹ *N. H.* 36, 195: ferunt Tiberio principe excogitato temperamento, ut flexile esset, totam officinam artificis eius abolitam, ne aeris, argenti, auri metallis pretia detraherentur, eaque fama crebrior diu quam certior fuit.

lived in the reign of Tiberius and who was besides not unduly skeptical, plainly disbelieved the account, it may be dismissed as a bit of malicious fiction.^{39a} The story, however, appealed to the popular imagination, and continued to be told long after classical times; it was also adapted to a French setting.⁴⁰ Von Lippmann⁴¹ has recounted the later tradition of this story.

E. GLASS WORKERS

Strabo (*S. I.*)¹ is the first to mention the *hyalourgos*² and it is from the glass workers of Alexandria that he received his information about glass. The first of the *vitrearii*³ mentioned in Latin literature

^{39a} There has been some effort to rationalize the story and connect it with a metallic substance, see H. de L'Isle, *L'Interméd. des Chercheurs et Curieux* (1864), 282; (1875) 469; Darcel (1874), 413; E. M. (1891), 244; G. Zero (1891), 374; Alf. D. (1891), 407. Berthelot, *Hist.* 1, 53, dismisses most of the story as legend, but believes that it may have an historical foundation: "Le verre incassable . . . paraît avoir réellement été découvert sous Tibère . . . 54: Il est curieux de la retrouver signalée dans les recettes d'orfèvres du moyen âge, comme si la tradition secrète s'en fût conservée dans les ateliers. En effet, il existe dans la *Mappae Clavicula*, au No. 69, une formule obscure, ou plutôt chimérique, ou entre le sang-dragon, et qui paraît se rapporter au même sujet: Sique factum scias vitrum fragile in naturam fortis metalli formari . . . C'est peut-être la recette même qui devait figurer sous le titre indiqué plus haut. J'ai rencontré quelques autres indices des mêmes souvenirs dans des auteurs plus modernes, tels que le faux Raymond Lulle et les autres alchimistes du moyen âge, qui s'en sont fort préoccupés. On sait que le procédé du verre incassable a été découvert de nouveau de notre temps, et cette fois sous une forme positive, sans équivoque et d'une façon définitive." Lulle, *Bibl. Chem.* 1, 849: "atque hoc etiam reddit vitrum malleabile." 3, 165: "Est sciendum quod antiqui sapientes, quatuor principales effectus sive virtutes in hac gloriosa thesauri arca, consolatrice et adjutrice Scientia repperunt . . . quarto omne vitrum ductibile facere, sive malleabile. There are a number of references to the metallic nature of glass in the *Bibliotheca Chemica*: 1, 28, 29, 317, 376; 2, 566, 567.

⁴⁰ Dillon, *op. cit.* 78, says that a similar tale was told of a French inventor, in which Richelieu takes the place of Tiberius.

⁴¹ *Zur Geschichte des Glases im Altertume (Abhandlungen u. Vorträge zur Geschichte der Naturwissenschaften* (1906), 76). In addition to the authors mentioned in the text, Damianus, John of Salisbury (quoted in Krause, *Angeologie* (1854), p. 42, n. 4), Bartholomäus Anglicus, Agrippa (*de Vanitate Scientiarum*, 110), Sebastian Franck, and the *Gesta Romanorum* (*de Invidia*, 98) are said to treat of the story of malleable glass. To this list should be added Heraclius, 3, 6. K. F. Smith spoke on the *Classical Tradition of Malleable Glass* at the meeting of the American Philological Association in 1915 (see *P. A. P. A.* 46 (1915), VII), but his paper was not published before his death.

¹ See above, p. 98, n. 7.

² See above, p. 50, n. 12ff. Cf. p. 50, n. 3ff.

³ See above, p. 66, n. 2ff.

is the fabulous inventor of unbreakable glass,⁴ called a *faber* by Petronius. In late Greek writers several stories are told of individual workmen. In the reign of Justin (S.6) a Hebrew *hylepsos* threw his son into the glass furnace because he partook of Christian bread, so the story goes, but the son was miraculously saved, and the father put to death—a fable which received wide circulation.⁵ In the next century the conversion of a Jewish glass worker is related by Leon-tius (S. 7).⁶ As the people sat about the furnace warming themselves, a dispute arose between the Jew and the Christians. Saint Symeon Salus, as the story goes, began miraculously to cause the breaking of the vessels which were about the room and continued to do so until the glass worker had crossed himself. Joannes Moschus (S. 6/7) tells of a workman who had been blinded by the fire.⁷ Bede (S. 7/8) calls the glass-maker a *vitricator*,^{7a} *vitricfactor*, or *vitri factor*.^{7b} He

⁴ See above, p. 110f.

⁵ Michael Glycas, *Annal.* 4 (*Script. Hist. Byz.* 27 (1836), 506): κατ' ἐκεῖνο καιροῦ ἀνεφάνη καὶ ὁ ὑελεψὸς Ἰουδαῖος ὁ τὸ παιδίον αὐτοῦ διὰ τὸ ἐνωθῆναι Χριστιανοῖς παιδίοις καὶ φαγεῖν ἀπὸ τῆς μυστικῆς τραπέζης βαλὼν εἰς τὸν κάμινον, εἰ καὶ οὐκ ἐφλέχθη τῆς θεοτόκου φυλαξάσης αὐτό, καθὰ δὴ τὸ παιδίον διεβεβαιοῦτο· ταύτῃ τοι καὶ τοῦ τοιοῦτου θαύματος διὰ τοῦ πατριάρχου Μηνᾶ γνωρισθέντος τῷ βασιλεῖ, μετακαλεῖται ὁ Ἰουδαῖος· πολλὰ τοίνυν παραινθεῖς καὶ μὴ πεισθεὶς τῆς οἰκείας ἀποστερεῖται ζωῆς ὡς φονεὺς τοῦ ἰδίου παιδός. Georgius Cedrenus, *Hist. Compend.* (*Script. Hist. Byz.* 34 (1838), 686ff.): ἐπὶ τούτου τοῦ εὐσεβεστάτου Ἰουστίνου Ἰουδαῖος τις ἐν τῇ πόλει ὑελοψὸς παιδίον ἐκέκτητο . . . ὁ δὲ δόλιος ἐκεῖνος θῆρ σφόδρα μανείς, μετὰ τὸ ἀριστῆσαι λαβὼν τὸ παιδίον καὶ ἀπελθὼν εἰς τὸ ἐργαστήριον αὐτοῦ ἔρριψεν αὐτὸ εἰς τὴν κάμινον καὶ κλείσας τὴν θύραν ἀνεχώρησεν . . . ὅθεν καὶ προσέταξεν αὐτὸν ἀνασκοποισθῆναι ὡς φονέα γενόμενον τοῦ ἰδίου παιδίου. Cf. Evagr. *Hist. Eccl.* 4, 36. Greg. Tur. *de Glor. Martyr.* 10 (*Patr. Lat.* 71, 714ff.): Judaei cuiusdam vitrarii filius . . . conclamabant etiam ut auctorem huius sceleris in ipsas prolicerent flammis. proiectum autem ita totum ignis absorbuit, ut vix de ossibus eius parvum quodammodo relinqueretur indicium.

⁶ *Patr. Gr.* 93, 1736 D: ἦν δὲ πάλιν ἄπαξ καθήμενος μετὰ ἀδελφῶν, καὶ θερμαινόμενος πλησίον τοῦ καμινίου τοῦ ὑελεψοῦ· ἦν δὲ ὑελεψὸς Ἑβραῖος, καὶ λέγει τοῖς πτωχοῖς παῖζων, κτλ.

⁷ *Pratum Spirituale* (*Patr. Gr.* 87, 2932 A): σὺ πῶς γέγονας τυφλός; ἀπεκρίθη κάκεῖνος λέγων· ὑαλοψὸς ἦμην τὴν τέχνην, καὶ ἐκ τοῦ πυρὸς ἐπίχυσιν ἔσχον οἱ δύο ὀφθαλμοί, καὶ ἐτυφλώθην.

^{7a} See above, p. 78, n. 68.

^{7b} *Homil.* 17, in *Natale Sancti Benedicti Episcopi* (*Patr. Lat.* 94, 228 A): toties mari transit . . . nunc vitrificatores ad fenestras eius decorandas ac muniendas. *Vita quinque SS. Abbatum*, 5: proximante autem ad perfectum opere, misit legatarios Galliam, qui vitri factores, artifices videlicet Brittanniis eatenus incognitos, ad cancellandas aecclisiae porticumque et caenaculorum eius fenestras adducerent. factumque est, venerunt; nec solum opus postulatum compleuerunt, sed et Anglorum ex eo gentem huiusmodi artificium nosse ac discere fecerunt; artificium nimirum vel lampadis aecclisiae claustris, vel vasorum multifariis usibus non ignobiliter aptum. See Plummer, *ad loc.* p. 359.

says that in the year 675 Benedict, founder of Wearmouth, sent to Gaul for *vitrifactores*, 'glassmakers,' also called *artifices*, 'artificers,' to decorate and enclose the windows of his church, the cloisters, and dining-rooms, because such workmen were unknown in England. The glassmakers came and not only completed their work but also taught their art to the English nation. This instruction does not seem to have had a lasting influence, however, for in a letter of about the year 758 Cuthbert,⁷⁰ abbot of Wearmouth and Jarrow, asks Lullus, archbishop of Mainz, to send him a *vitrifactor*, because, in Cuthbert's words, "we are unacquainted with and unskilled in this art." But we look in literature in vain for the names of the workmen, unless possibly a scholiast of uncertain date on Lucian's *Lexiphanes*,⁸ in an erroneous explanation of a word, speaks of a glass-maker Mentor because he was familiar with a glass-worker by that name.⁹

On grave monuments the names of a few glass-workers have been preserved. Euphrasios is mentioned on a Jewish or Christian sepulchral inscription in Athens.¹⁰ In Mauretania there was a *vitriarius* Antas whose name occurs upon the sepulchral inscription of his little son.¹¹ Julius Alexander was likewise a native of Africa, a Carthaginian citizen, who was evidently living at Lyons at the time of his death.¹² If Carthage preserved the traditions in

⁷⁰ *Epist.* 22 (*Patr. Lat.* 96, 839 B/C): si aliquis homo in tua sit parrochia qui vitrea vasa bene possit facere, cum tempus arrideat, mihi mittere digneris, aut si fortasse ultra fines est in potestate cuiusdam alterius, sine tua parochia, rogo ut fraternitas tua illi suadeat ut ad nos usque perveniat, quia eiusdem artis ignari et inopes sumus, et si hoc fortasse contingit ut aliquis de vitrifactoribus cum tua diligentia, Deo volente, ad nos usque venire permittatur, cum benignia mansuetudine, vita comite, illum suscipio.

⁸ Rabe, *Schol. in Luc. Lex.* 7 (1906), 197: μεντορουργής δὲ ἀπὸ Μέντορος τινος ὑαλοφού τοῦτῳ καταχρησαμένου τῷ εἶδει τῶν ποτηρίων.

⁹ See below, no. 11.

¹⁰ I G 3, 3436: κυμητ[ή]ριον Εὐφρα|σείου οἰαλᾶ | κε Γενναδί|as. See above p. 41, a.

¹¹ CIL 8, 9430 (Renier, *Inscr. Rom. de L'Algérie* (1855-1886), 3944): Saburrio, Antae vitrari et Paulas (=ae) f(ilius), vixit menses sex.

¹² CIL 13, 1, 1, 2000 (Wilmanns, *Ex. Inscr. Lat.* 2 (1873), 2591): D. M. et memoriae aeternae Iuli Alexsandri natione Afri civi Carthaginesi omni optimo opifici artis vitriae qui vix anos LXXV menses V dies XIII sene ulla lesione animi cum coniuge sua Virginia cum qua vixit annis XXXXVIII ex qua creavit filio III et eiliam (*sic*) ex quibus his omnibus ne potes vidite deos supest ites (*sic*) sibi reliquit hunc tumulum ponendum CV raverunt Numonia Bellia uxor et Iulius Alexsius filius et Iulius Felix filius et Iulius Gallonius filius et Numonia Belliosa filia *item* nepotes eius Iulius Auctus Iulius Felix Iulius Alex(?)sander Iulius Galonius Iulius Leontius

glass-making of the mother country, it would not be strange to find him a skilled workman, and like many of his eastern relatives seeking a wider field in the northern provinces. Perhaps a glass manufacturer of Gaul called him to that place. It is possible that the inscription *Alexandrou*, 'of Alexander,' on a vessel of green glass, may indicate the work of Julius Alexander.¹³ Another fragmentary inscription of the same kind has been found in Dalmatia.¹⁴

During the late republic and early empire workmen began to sign their works. If we turn to the glass objects themselves, we find out more about the workmen than their mere names. The form of the object indicates whether the maker was an artist or an ordinary workman; the name furnishes some idea of the nationality of the workman; the places where objects made by the same man are found in abundance may indicate the locality in which he plied his trade; and their number may give some idea of the extent of the manufacture, in spite of the differences in the durability of vessels. Most of the names on the artistic glasses are Greek; they seem to have belonged largely to Sidonians or related Orientals, to judge from the number who called themselves Sidonians, as Aristo, Artas, Eirenaïos, Neikon, and Philippos. The works of others, especially Ennion, show such a similarity that they doubtlessly belonged to the same school of workmanship. The wide range of distribution of these signed cups makes it impossible to tell just where the individual workmen plied their trade. Some, as Ennion, whose works are widely distributed in the East, may have worked there; while others, especially Artas, most of whose works are found in Rome, probably established their factories in that city.¹⁵ Pliny has told us of the fame of Sidon, the *artifex vitri*, and of the newer processes which had grown up in his own country. After Rome came to rule the East, it would be strange if some Oriental workmen did not seek better conditions for employment and a new center for trade in the West. Aside from the excellence of workmanship on these signed vessels, the name Sidonian, no doubt, appealed to many even before the names of the makers came to be coveted trade-

Iulius Gall . . . Iulius Eonius P/P Cyri *et sub asc* dedicaverunt. For an illustration of the monument, see Alph. de Boissiev, *Inscr. Ant. de Lyon* (1846-1854), 26, 427.

¹³ See below, no. 1.

¹⁴ CIL 3, Suppl. 1-2, 9542: IC | | A PASC ASIO(?) O VITRARIO |

¹⁵ Kisa, *op. cit.* 705ff.; Frank *op. cit.* 13, 160; West (*T.A.P.A.* 55 (1924), 173).

marks. The pride which these workmen took in their most fragile of arts is shown by another inscription on cups of Meges, Ennion, and Jason, a record which reminds one of the ancient sepulchral inscriptions, the expression of a common longing for immortality: on one handle, *Meges epoësen*, 'Meges made (me),' and on the other *mnêsthê o agorasas*, 'let the buyer remember him,' and similarly, *Enniôn epoïësen*, 'Ennion made (me),' and *mnêsthê o agorazôn*, 'let the buyer remember him'¹⁶ and *Jasôn epoïësen*, 'Jason made (me),' *mnêsthê o agorasas*, 'let the buyer remember him'.^{16a}

Among the workmen bearing Greek names not all were from Sidon or related cities; there was one whose name has an Egyptian form: *Bounneri Kerami*, Bounneri the potter.¹⁷ This signature on a painted glass medallion in the Museo Cristiano at Brescia, is interesting also as showing that it was possible to apply the term *kerameus*, 'potter,' to a glass worker.¹⁸ It is not improbable that glass making developed from the glazing of pottery, but it is impossible to tell to what extent they were carried on side by side. If one should make a comparative study of the inscriptions on glass and pottery, it might be possible to determine whether these wares were ever put out by the same factories. Thus the *Of(ficina) Frontini*,¹⁹ a designation which appears so frequently upon pottery, might refer to the same factory, or at least the same management as the *Frontin(iana) o(fficina)* from which so much glass has been preserved.

The use of Roman and Gallic names was usually of a more commercial than artistic nature. A few workmen signed their names in full, for example L. Aemilius Blastus, L. Arlenus Iapis, L. Brittius Secundus, P. Gessius Ampliatus, G. Leuponium Borvonicus, and A. Volumnius Ianuarius. Often the cognomen alone is used, frequently accompanied by *fecit* as *Felix fecit*, 'Felix made (me).' Others to use *fecit* or an abbreviation of it were Amarantus, Attianus, Daccius, Equa(sius?) Lupio, Gaïamillus, Marcus, and

¹⁶ Cesnola, *Cyprus* (1878), no. 26, 28; Kisa, *op. cit.* 708-710.

^{16a} Dussaud (*Syria*, I (1920), 231f.).

¹⁷ Garrucci, *op. cit.* ed. 2, Pl. 42, no. 7; Venturi, *Storia dell'Arte Ital.* I (1901), 406; Albizzati, *Mitteilungen des Kaiserl. Deutsch. Archaeol. Inst.* 29 (1914), 247; F. de Mély, *Le Médaillon de la Croix du Musée Chrétien de Brescia (Arethusa*, 3 (1926), 1ff.).

¹⁸ Oldfather, *Kerameus of a Worker in Glass* (*Four. Amer. Ceram. Soc.* 9 (1926), 663).

¹⁹ CIL 2, 4970, 204; 3, 2, 6010, 92; 12, 5686, 369; 13, 3, 110010, 920. Cf. *Fronto*, CIL 2, 1, 6699, 92; Suppl. 3, 12014, 39; 12, 5686, 370, and *Fron*, *Frontinus*, O *Fronti*, CIL 7, 1336, 465, 467, 469.

C. N() Magunus. Possibly the same idea was expressed by the use of the letter *m* for *manu*, 'by the hand of,' as in the case of Q. Casius Nocturnus.²⁰ Some vessels simply bear the name of the corporation, or owner of the factory. Groups of names like FIRM HILARI ETYLAE, placed one above the other, might well stand for a corporation, that of the Firmii brothers, Hilarus and Hylas. G. Appius Apinossus, Frontinus, Irenus (?), Laurentius, Osto(r)ius On(e)si(mus), and Titienus Hyaci(nthus) were owners of *officinae*, 'factories.'²¹ The factory of Frontinus was probably in Gaul, if one may judge from the frequency of the finds made there. These finds would also lead one to conclude that his trade was very large. Some of his workmen, as Asiaticus, Equa(s)ius), P() Divixtus, Pax, Prometheus, Protius, signed their work. One of the workmen in the factory of Appius Apinossus also signed his work, but he abbreviated his name so that it is not possible to be sure of its exact form. In fact most of the workmen of Italy and the northern provinces abbreviated their names or used initials to the extent that it is often impossible to decipher some of those which occur most frequently. These initials vary from one to many, often occurring in the corners of the bottom of the vessel. At other times the letters are arranged in a circle, semi-circle, in a highly complicated monogram, or irregularly. When a vessel bears an inscription commemorating victories, games, mythological or Christian characters, designating the region of manufacture, or expressing words of greeting or friendship, it is not always possible, especially if it is in a fragmentary condition, to determine whether the name stands for the maker or some character in connection with the commemoration. A list of the names of the glass makers will be given at the end of this section.

The Jews seem to have gradually gained control of the industry in the east. We have already mentioned stories of two Jewish glass makers. In the twelfth century Benjamin of Tudela, a Spanish Rabbi, in his travels tells of New Tyre (Tsour). He says that about four hundred Jews resided here, that the Jews were shipowners and manufacturers of the far famed Tyrian glass.²² He also described a

²⁰ See below, no. 29.

²¹ See below, p. 120ff. Perhaps also EX . . . CIN . . . CIL 5, 8118, 6; Kisa, 962, 255.

²² Asher's translation 1 (1840), 63 (30, 2). Marquardt, *op. cit.* 2, 723. Dillon, *op. cit.* 148: "The Jews long before that time had, it would seem, a monopoly of glass made with lead."

section of Antioch which was strongly fortified and in the possession of Prince Bohemond of Poitiers. There were about ten Jews here; they were glass manufacturers, and the most important of their number were: R. Mordekhai, R. Chaiim, and R. Jishma'el.²³

There are other references in literature and the laws which, although not mentioning individual workmen, give glimpses of the duties and social standing of glass workers in general. The 'papyrus of the glass makers' has been discussed under fuels (p. 104). It was thought best for the workmen to shake the stalks so that a salamander would not fall into the fire and put it out.²⁵ Of a much earlier date is the epigram of Mesomedes (*S.* 2),²⁶ which describes the making of glass and the handling of it. "The workman having quarried it, brought the glass and put in the fire the mass hard as iron, and the glass set afire by the all-devouring flames, ran out melted like wax. And to the men it was a marvel to see a trail flowing from the fire and the workmen trembling lest it should fall and break; and on the points of the double forceps he put the lump." The fragility of glass and the danger of a workman's breaking it are discussed.²⁷ Among the duties of the workman most commonly mentioned is the blowing of the glass. A scholiast on Hippocrates (*S.* 7)²⁸ says that the workman by blowing produces the opening and the shape of the vessel. In the catalogue of the Greek manuscripts on Mount Athos, 4503, 32, is "Concerning the glass smelter."²⁹

The glass worker was subject to various legal regulations. In the early part of the first century after Christ he is mentioned in a list of traders or artificers in the Tebtunis papyri.³⁰ In another papyrus of the same period or slightly earlier, the glass worker appears upon the taxing-list.³¹ A tax was placed upon glass workers in the third century by Alexander Severus.³² Aurelian taxed glass

²³ Asher's translation I (1840), 58 (26, 2).

²⁵ See above, p. 104, n. 21.

²⁶ *Anth. Pal.* 16, 323: τὰν ὕελον ἐκόμιζε | κόψας ἐργάτας ἀνὴρ· | ἐς δὲ πῦρ ἔθηκε βῶλον, | ὥς σίδηρον εὐσθενῇ. | ἃ δ' ὕελος, οἷα κηρός, | ἐξεχείτο, παμφάγοισι | φλοξίν ἐκπυρούμενος | θαῦμα δ' ἦν ἰδεῖν βροτοῖς | ὄλκον ἐκ πυρός ῥέοντα, | καὶ τὸν ἐργάτην τρέμοντα, | μὴ πεσὼν διαρραγῇ. | ἐς δὲ διπτύχων ἅκμας | χηλέων ἔθηκε βῶλον. Translation by W. R. Paton.

²⁷ See above, p. 66, n. 2; p. 108, n. 43.

²⁸ See above, p. 107, n. 41.

²⁹ See above, p. 50, n. 6.

³⁰ See above, p. 51, n. 14.

³¹ See above, p. 51, n. 15.

³² Lamprid. *Alex. Severus*, 24, 5: braciorum, lintionum, vitrariorum, pellionum, claustrariorum, argentariorum, aurificum et ceterarum artium vectigal pulcherri-

imported from Egypt.³³ But under Constantine exemptions were granted to many artificers, including the *vitrearii* and *diatretarii*, that they might become more skilled in their art and see to the training of their sons.³⁴ In the Digest³⁵ there is an edict for the punishment of *diatretarii* who through carelessness break the goblets intrusted to them, but protecting workmen who had received material containing flaws. This sounds almost like a commentary on the passage in Martial^{35a} in which he speaks of how often the workman ruins his work while trying to improve it. The prosperity of some workmen is shown by the existence of large factories like that of Frontinus in which certain artisans, at least, might sign their own products. Streets,³⁶ and gates³⁷ were named from the glass industry carried on in their vicinity, as the Street of the Glass-Workers. Constantinus Harmenopulus,³⁸ in a compendium of laws drawn up in the fourteenth century, quotes extracts from Julian of Ascalon, who is otherwise unknown, but who must have lived before the Arab conquest of Palestine in 636. This edict states that workers in glass and iron should not carry on their business in the city, but, if that is necessary, the workshops should be in remote and sparsely populated parts of the city, to prevent sickness and the destruction of property by fire.

mum instituit ex eoque iussit thermas et quas ipse fundaverat et superiores populi usibus exhiberi.

³³ Vopisc. *Aurel.* 45, 1: vectigal ex Aegypto urbi Romae Aurelianus vitri chartae lini stuppae atque anabolics species aeternas constituit.

³⁴ *Cod. Theod.* 13, 4, 2: Imp. Constantinus A. ad Maximum pp. artifices artium brevi subdito comprehensarum per singulas civitates morantes ab universis muneribus vacare praecipimus, si quidem ediscendis artibus otium sit accomodandum, quo magis cupiant et ipsi peritiores fieri et suos filios erudire. D IIII non. Aug. Feliciano et Titiano cons. a. 337 . . . diatretarii . . . vitriarii. This is repeated in *Cod. Just.* X, 66, 1, with slight variations in spelling, *i.e.*, diatritarii V . . . vitrearii.

³⁵ See above, p. 110, n. 27.

^{35a} See below, p. 165, n. 109.

³⁶ See below, p. 131, n. 38, 40, 42. Cf. Glass-Maker's Street (now South William Street, New York City), Moore, *Old Glass* (1924), 210; Van Rensselaer, *Early American Bottles and Flasks* (1926), 97.

³⁷ See below, p. 134, n. 60.

³⁸ *Hexabiblos*, 2, 4, 19: 'Επαρχικὸν περὶ ὑελουργῶν (ἐλουργῶν Η) καὶ σιδηρο-
υρ γῶν. ὑελουργοὺς (ὑελουργὸς Η) καὶ σιδηρουργοὺς τοὺς ἐργαζομένους τὰς ἀξίνας
καὶ τὰς ἄμας καὶ τὰ τοιαῦτα μεγάλα ὄργανα, καὶ ἀνδριαντοπλάστας οὐ χρὴ ἐν αὐ-
ταῖς ταῖς πόλεσι τὰ τοιαῦτα ἐργάζεσθαι· εἰ δὲ ἀνάγκη τις γένηται τοῦτους κατοικεῖν
τὰς πόλεις καὶ τὰς τούτων ἐργασίας ἐν αὐταῖς γίνεσθαι, εἰς τοὺς ἀπωκισμένους καὶ
ἰδιάζοντας τῶν πόλεων τόπους δεῖν ταύτας ἐργάζεσθαι· πολλὺς γάρ ὁ ἀπὸ τοῦ πυρὸς
πέλων κίνδυνος τοῖς οἰκήμασι καὶ τοῖς σώμασι συνεχῆς λοιμὸς γίνεται.

NAMES AND INSCRIPTIONS OF GLASS WORKERS³⁹

A. Greek

1. **Alexandrou**.—Froehner, *Nomenclature des Verriers Grecs et Romains* (1879), 9, CIL 15, 2, 1, 7001; IG 14, 2410, 1; IG 14, p. 707, VIII; Kisa, *op. cit.* 930, 43; cf. 194, 200.

2. **Aristo (Si)doni(us)**.—Froeh. 9, 2; CIL 2, 1, 6957, a-b; Kisa, 706; 923, 1.

3. **Artas Sidon(ius)**.—Froeh. 10, 3; CIL 5, 2, 8118; 9, 6085, 1; 10, 2, 8062, 2; 13, 3, 2, 10025, 1, a-f; 15, 2, 1, 6958, a-o; IG 4, 8479; 14, 2410, 1; Kisa, 92, 168, 175, 200, 301, 704-705, 923 (no. 2), 938 (no. 1).

4. **Bounneri Kerami**.—See above, notes 17-18.

4^a. **Dêmosthenou**.—IG 4, 8506: "Incertum artifex intelligendus sit au possessor."

5. **Eirênaios epoiêsen Sidonios**.—Froeh. 11, 5; cf. 10, 4; IG 4, 8484; 14, 2410, 2; Kisa, 95, 168, 704, 706.

6. **Enniôn epoiêsen**.—Froeh. 12, 6 (he also gives the readings *Aniion* and *Ainiôn*); IG 4, 8485; 14, 2410, 3; Dillon, 87; CIL 11, 2, 1, 6710, 15; Rossbach (*P.-W. s. v. Ennion*); Kisa, 708 f., 971. Reinach, *Antiquités du Bosphore Cimmérien* (1892), pl. 78: "Enniôn epoiei."

7. **Eugenês**.—Froeh. 13, 7; Kisa, 707.

8. **Euphrasios**.—See above, note 10.

9. **Zêthos**.—Froeh. 13, 8; CIL 12, 5696, 22; Kisa, 708.

9^a. **Zôsimou**.—Beaudouin-Pottier, *Bull. de Corresp. Hellén.* 3 (1879), 164.

9^b. **Iasôn epoiêsen**.—See above, note 16^a.

10. **Irenaeus**—Dillon, *op. cit.* 87. I have found no other reference to the name in this form. Compare, however, No. 5 just above.

10^a. **Megês**.—Froeh. 13, 9; Kisa, 708; IG 14, 2410, 3.

11. **Mentor**.—Froeh. 14, 10; See above, note 8.

12. **Neikôn Seidôn**.—Froeh. 14, 12; CIL 13, 3, 2, 10025, 2; 15, 2, 1, 6961; IG 14, 2410, 4; Kisa, 706, 924 (no. 4), 939 (no. 2).

13. **(Ph)ilippo(s) (Si)doni(os)**.—CIL 15, 2, 1, 6962; Kisa, 706, 924 (no. 5); See below, number B, 15.

14. **S() A()epo(i)ê(sen)**.—CIL 15, 2, 1, 6963; Kisa, 924, 6. They also suggest the reading *V. S(idonius)*.

15. **Tiberinou**.—CIL 15, 2, 1, 7002; Kisa, 930, 44. Cf. *BEPIN*, CIL 13, 3, 2, 10025, 157; Kisa, 953, 151.

16. **Triphônos**.—Kisa, 756.

17. **Tryphon**.—Dussaud (*Syria*, 1 (1920), 230).

³⁹ The names will be given as they appear in the signatures on the glass objects, when they are taken from that source.

B. Latin⁴⁰

a. Names and Partially Intelligible Abbreviations

1. Marcus A C—Froeh. 16, 13.
2. Cn. A() Ing(enui) VAMAF.—CIL 12, 5696, 18; Kisa, 925, 8. Froeh.: "*Marcus, Cnaeus et Aulus Ingu. . .*"
3. Publius Accius Alcimus.—Froeh. 17, 15.
4. L. Aemili Blasti.—Froeh. 17, 16; CIL, 5, 2, 1082; 10, 2, 8062, 1; 11, 1, 6710, 3; 15, 2, 1, 6990, a-c; Abramić-Colnago, *Jahresheft des öster. arch. Inst.* 12 (1909), 81; Kisa, 929, 32.
5. Aem(ili) Mau(ri)?—CIL 15, 2, 1, 6991; Kisa, 929, 33.
6. C. Al() Ruf() f(ecit).—CIL 13, 3, 2, 10025, 3, a-d; Kisa, 939, 3. Cf. Froeh. 88.
7. Amarantus F().—Froeh. 31, 46; CIL 13, 3, 2, 10025, 5; Kisa, 939, 4 (*F, M* and *A* as well as *N* and *T*).
8. M. Anc() Ar() Pr(imus) or Pr(imus?) M. Anc() Ar().—CIL 15, 6966; Kisa, 925, 9. Cf. *NC.AP.P*, CIL 11, 2, 1, 6710, 4, and *MANC A*, CIL 13, 3, 2, 10025, 7; Kisa, 940, 6; 966, 305. *M. Anc[ar(ius) Prim]o*, Abramić-Colnago, 80.
9. Lucius An(nius)? B—Froeh. 18, 17.
10. Antas.—See above, note 11.
11. G. Appi Apinossi (*i.e.* officinae magistri), Aur(elius) Gel() f(ecit).—Froeh. 18, 18; CIL 13, 3, 2, 10025, 132; Kisa, 951, 126.
12. L. Arleni Iapidis.—Froeh. 18, 19; CIL 12, 5696, 3; Kisa, 963, 270.
13. Aretius.—CIL 12, 5696, 2. Kisa, 963, 269: "Vielleicht schlecht gelesen."
14. (Ex officina) Front(iniana) Asiat(i)ci.—Froeh. 41, 66; CIL 13, 3, 2, 10025, 49, a-b; Kisa, 945, 47.
15. Asini P(h)ilip(p)i.—Froeh. 19, 20; CIL 1, 1, 1, 2400; 15, 2, 1, 6960; Kisa, 177, 188, 722, 924 (no. 3); Cf. above, number A, 13.
16. Attianus F.—CIL 13, 3, 2, 10025, 72; Kisa, 947, 70.
17. Front(iniana) S(extarii) II, A(u)oni(?).—CIL 13, 3, 2, 10025, 50, a-b; Kisa, 945, 48.
18. Aur(elius) Gel(). (See above, number 11.)
19. S(ocius)—C. Au(relius) Mu(cianus) Cn(eius) Vin(ius).—Kisa, 779.
20. C. Aur(eli) Pr—CIL 10, 2, 8062, 3; Kisa, 962, 257.
21. (Ex officina) Fronti(niana) t Bassilian(us) f(ecit).—CIL 13, 2, 10025, 67; Kisa, 947, 65.
22. Frot Bis.—CIL 13, 3, 2, 10025, 51, a-c; Kisa, 945, 49.

⁴⁰ This list has been compiled from CIL, Froehner, Kisa, and other recent sources. There has been no attempt to separate the nomina from the cognomina. All initials and abbreviations which have been suggested previously as belonging to workmen, or which apparently do so, will be included in this list.

23. **L. Britti Secundi**.—CIL 10, 2, 8062, 4; Kisa, 962, 258.
24. **Caecili Hermetis**.—CIL 15, 2, 1, 6968; Kisa, 925, 11.
- 24^a. **C(aius) Lavo . . . or Claud(ius)**.—Haug und Sixt, *Die Röm. Inschrift. und Bildwerke Württembergs*, ed. 2 (1914), 566.
25. **Calgaci(?)**.—CIL 13, 3, 2, 10025, 161. Kisa, 953, 155, reads: "*Caleagus*." Cf. Froeh. 48, 87.
26. **Caran(t)o a() v()**.—CIL 13, 3, 2, 10025, 32; Kisa, 943, 30.
27. **Capnus Adiat/i(?)**.—CIL 12, 5696, 4; Kisa, 963, 271.
28. **Carantius Ca(ra)ntodius Ci(vis) Leucus**.—CIL 13, 3, 2, 10025, 136; Kisa, 938; 951, 131.
29. **Q. Casi Nocturni m(anu?)**.—Kisa, 951, 131. CIL 13, 3, 2, 10025, 137, a-b (*M*, not *manu*).
30. **Cebei Yllici (= Hyllici)**.—Thédenat (*Rev. de Philol.* 11 (1887), 255); CIL 13, 3, 2, 10025, 33, a-d (readings *Clebi Bullici* and *Cledi Bullici*, mentioned, *Idem*, b.); Kisa, 937c (mentions the reading *Cebei Illici*); 943, 31.
- 30^a. **T. Cl. C.**—CIL 13, 3, 2, 10025, 75; Kisa, 947, 72.
31. **Claudi Onesimi**.—CIL 15, 2, 1, 6992; Kisa, 929, 34.
32. **Com For Fron()**.—CIL 13, 3, 2, 10025, 52, a-e; Kisa, 945, 50.
33. **Q. Cor(io)lani(?)**.—Kisa, 961, 245.
34. **O. Cosani**.—CIL 13, 3, 2, 10025, 76; Kisa, 947, 73. Cf. Froeh. 21, 25: "*Quintus Cosamus?*"
35. **Daccius F()**.—Froeh. 21, 26; CIL 13, 3, 2, 10025, 34, a-b; Kisa, 943, 32.
36. **Dirus**.—CIL, 13, 3, 2, 10025, 120; Kisa, 950, 115. Froeh. mistakes for *Firm*.
37. **S() E() I()**.—CIL 13, 3, 2, 10025, 78; Kisa, 947, 75.
38. **Ennia Fortuna**.—CIL 15, 2, 1, 6993; Kisa, 929, 35.
39. **Ep(pius)? Vilicus**.—Froeh. 22, 27.
40. **Equa(sius?) Lupio fecit**.—CIL 13, 3, 2, 10025, 36, a-c; Kisa, 943, 34. Cf. *Equa* and *Ecva*, Kamp, *Die epigraph. Anticaglien in Köln* (1869), 143, 144; Froeh. 89, 90; CIL 13, 3, 2, 10025, 35, a-g; 54; Kisa, 937c; 943, 33; (*Ex officina*) *Frontiniana Equa (sii?)*, CIL, 13, 53; Kisa, 788; 945, 51-52.
41. **Cr(assius) Euhodia(nus)**.—Froeh. 47-49; CIL 12, 5696, 5; 13, 3, 2, 10025, 15-17; 15, 2, 1, 6975; Kisa, 926, 18; 941, 14-15.
42. **Etiticae**.—Froeh. 91; CIL 13, 3, 2, 10025, 162. Kisa, 953, 156, reads: "*Teticiae*."
43. **F() P() (ex officina) Front(iniana)**.—Froeh. 69; CIL 13, 3, 2, 10025, 55; Kisa, 946, 53.
44. **Felix fecit**.—CIL 7, 1275a; 13, 3, 2, 10025, 37; Kisa, 943, 35; 967, 310. *Felix* appears alone, Froeh. 50; CIL 13, 79; Kisa, 947, 76.
45. **Firm(iorum)**.—CIL 13, 3, 2, 10025, 19, a-f; 15, 2, 1, 6977, a-d; Kisa, 927, 20; 941, 17. Cf. Froeh. 51-52: "*Firmus*."

46. **Firm(iorum) Hilari et (H)ylae.**—CIL 11, 2, 1, 6710, 7; 13, 3, 2, 10025, 18, a-e; 15, 2, 1, 6976, a-i; Kisa, 784; 926, 19; 941, 16. Dressel was the first to give the above interpretation. Cf. Froeh. 53-57; Dillon, 88: "*Firmus, Hilarus, and Hylas.*"

47. **(Ex officina) Fro(n)tiniana.**—CIL 13, 3, 2, 10025, 38; Kisa, 943, 36. This factory is known by many stamps: *Frotinia*, CIL 13, 39, a-b; Kisa, 37; *Fronino* or *Frontino*, Froeh. 60; CIL 13, 40, a-e; Kisa, 38; *Fronti*, Froeh. 63; CIL 13, 41, a-e; Kisa, 39; *Fronio*, CIL 13, 42; Kisa, 40; cf. Froeh.: "*Frontio*"; *Froti*, Froeh. 75; CIL 13, 43, Kisa, 41; *Front*, *Fronti*, Froeh. 64-65; CIL 13, 44, a-f; Kisa, 42; *Frot*, Froeh. 77; CIL 13, 45, a-c; Kisa, 43; *Fron*, Froeh. 72; 82 (*Nero* by mistake); CIL 13, 46, a-v; Kisa, 44; *Fro*, Froeh. 78-79; CIL 13, 47, a-q; Kisa, 45; *F*, CIL 13, 48; Kisa, 46; *Frontitrof* (with *R* and *F* backwards), CIL 13, 56, a-c; Kisa, 54; *Frontisse*, CIL 13, 66; Kisa, 64 (perhaps incorrectly read); see numbers 14, 17, 21, 22, 34, 42, 45, 58, 71, 84, 89, 95, 96, 99, 102. See Kisa, 787 ff.; Nesbitt, 96.

48. **Frati (or Erati).**—CIL 13, 3, 2, 10025, 70; Kisa, 68. Froeh. 74 mistakes for *Froti*.

49. **S() G() F().**—CIL 13, 3, 2, 10025, 80; Kisa, 77. Froeh. 29: "*Sextus G B.*"

50. **Gaiamillus f(ecit).**—CIL 13, 3, 2, 10025, 82; Kisa, 937; 948, 79.

51. **Gal(erius) Pat(ernus)(?).**—Froeh. 30. Without interpretation, CIL 13, 3, 2, 10025, 11.

52. **Germ(anus?).**—Froeh. 80; CIL 13, 3, 2, 10025, 142.

53. **P. Gessius Ampliatus P F.**—Froeh. 31; CIL 10, 2, 8062, 5; Kisa, 962, 259.

54. **Hyla(e).** (See 46.)—Froeh. 81; CIL 11, 2, 1, 6710, 8; 13, 3, 2, 10025, 20, a-b; 15, 2, 1, 6979, a-c; Kisa, 927, 22-23; 941, 18.

55. **A. I() M().**—CIL 13, 3, 2, 10025, 84; Kisa, 948, 81.

56. **(Ex officina) Fro(ntiniana) Ip() or I() P().**—CIL 13, 3, 2, 10025, 57; Kisa, 946, 55.

57. **O(fficina) Ireni O(fficina).**—CIL 13, 3, 2, 10025, 85; Kisa, 948, 82.

58. **Iulius Alexander.**—See above, note 12 and above, number A, 1.

59. **Marcus Iulius M**—Froeh. 34.

60. **I. LVLIV.**—According to Villefosse, *LLVLIV* above *MIV*. CIL 12, 5696, 7; Kisa, 963, 273. Froeh. 35: "*Lucius Iulius? M*"

61. **Ius(ti or -tini).**—CIL 13, 3, 2, 10025, 86; Kisa, 948, 83.

62. **Iustivi CI . . . IV . . SSC.**—CIL 13, 3, 2, 10025, 104; Kisa, 949., 100. Cf. Froeh. 45.

63. **Ofikina Laurenti v().**—Deloche (*Philol. Wochenschr.* 2 (1882), 538); Thédénat (*Rev. de Philol.* 11 (1887), 255); CIL 13, 3, 2, 10025, 144; Kisa, 952, 138.

64. **G. Leuponi Borvonici.**—Froeh. 36; CIL 13, 3, 2, 10025, 146; Kisa, 952, 140.

65. **L. Licinius Diceus f(ecit).**—CIL 3, 184; Kisa, 740.
 65^a. **A. Lu.**—CIL 12, 5696, 9; Kisa, 963, 275.
 66. **C. Lucre(t)i EVL.**—CIL 3, 2, 10025, 8; Kisa, 940, 7.
 67. **(L)ucreti Festivi.**—Froeh. 37; CIL 15, 2, 1, 6994; Kisa, 929, 36.
 68. **(Ex officina) Fron(t)in(iana), M() M().**—CIL 13, 3, 2, 10025, 58, a-e; Kisa, 946, 56. Froeh. 73: "*Fro(t)inia' N A.*"
 69. **Macn(i or -ae).**—CIL 13, 3, 2, 10025, 27, a-b; 15, 2, 1, 6980, a-f; Kisa, 927, 23; 942, 25. Cf. *ANIAE MACN* above a *P*, CIL 13, 3, 2, 10025, 150; Kisa, 952, 144 (*G* instead of *C*). Froeh. 24: "*(Calpu)rnia? Magna.*"
 70. **M() Mai(ani?).**—CIL 13, 3, 2, 10025, 69; Kisa, 947, 67.
 71. **Marcus f(ecit).**—CIL 12, 5696, 10; Kisa 964, 276.
 72. **Quin. . -Mau. S.**—CIL 3, Suppl. 1, 2, 10187, 7.
 73. **Merco F.**—CIL 12, 5696, 11; Kisa, 964, 277.
 74. **C. N() Magunus v() f(ecit).**—CIL 13, 3, 2, 10025, 151; Kisa, 952, 145.
 75. **Nae.**—Kamp, *Die epigraph. Anticaglien in Köln* (1869), 139; Froeh. 94; CIL 13, 3, 2, 10025, 91.
 76. **Ne() Me().**—CIL 13, 3, 2, 10025, 21; Kisa, 941, 19.
 77. **Ner Caspe.**—Froeh. 95; CIL 5, 8118, 7; Kisa, 962, 256.
 78. **Optus(?).**—Froeh. 83.
 79. **T Orm() Sici()(?).**—CIL 13, 3, 2, 10025, 107; Kisa, 949, 103.
 80. **Ex of(ficina) Osto(ri?) On(e)si(mi).**—CIL 15, 2, 1, 6995; Kisa, 930, 37.
 81. **(Ex officina) Frontiniana P() Divixti.**—CIL 13, 3, 2, 10025, 59; Kisa, 946, 57. Cf. *DIVI XTIM*, CIL 13, 3, 2, 10025, 140; Kisa, 952, 134.
 82. **S(extus) P . . . S**—Froeh. 38; CIL 12, 5696, 12.
 83. **V. P. Piroc.**—CIL 13, 3, 2, 10025, 163; Kisa, 954, 157.
 84. **Patrimoni.**—Froeh. 22-23; CIL 11, 2, 1, 6710, 5; 11, 2, 2, p. 1170; 12, 5696, 19, a-b; 20 (*Patr Manib* male lectum esse pro *PATRI MONI*); 13, 3, 2, 10025, 9; 15, 2, 1, 6967, a-j; Kisa, 925, 10; 940, 8. Both disapprove of Froeh. 21: "*Publius Atrius Moni(mus?)*." Abramić-Colnago (1909), 79; Haverfield, *Jahrb. des Arch. Inst.* (1914), 403.
 85. **Paul ().**—CIL 13, 3, 2, 10025, 94; Kisa, 949, 90.
 86. **(Ex officina) Front(iniana) Pax (fecit).**—CIL 13, 3, 2, 10025, 60, a-b; Kisa, 946, 58.
 87. **C. Peduc(aeus) Thyra.**—Froeh. 39; CIL 15, 2, 1, 6969; Kisa, 925, 12. Cf. *PEDUC. THYY. AC.*, CIL 10, 2, 8062, 7; Kisa, 962, 261.
 88. **L. Pol.**—CIL 13, 3, 2, 10025, 153; Kisa, 953, 147.
 89. **(M?) Polli Bass(i).**—CIL 15, 2, 1, 6996; Kisa, 930, 38.
 90. **M. Primi.**—CIL 13, 3, 2, 10025, 154; Kisa, 953, 148. Cf. *PRIMI ET*, CIL 10, 2, 8062, 6; Kisa, 962, 260.
 91. **Priscus.**—CIL 12, 5696, 13; Kisa, 964, 279.

92. **Prometheu(s fecit ex officina) Fro(n)ti(niana).**—CIL 13, 3, 2, 10025, 61, a-d; Kisa, 946, 59. Froeh. 84: "*Prometheus Frontini (servus).*"
93. **(Ex officina) Fron(tiniana) Proti.**—Froeh. 71; CIL 13, 3, 2, 10025, 62; Kisa, 947, 60.
94. **P. R() Q() v().**—CIL 13, 3, 2, 10025, 155; Kisa, 953, 149.
- 94^a. **(R)ufin(i) (?)**.—Abramić-Colnago (1909), 81. CIL 13, 3, 2, 10025, 14; Kisa, 940, 12, read "*VLI.*"
95. **Front(iniana) S() C() f(ecit).**—Froeh. 68; CIL 13, 3, 2, 10025, 64, a-c; Kisa, 946, 62. *Frontiniana S() C()* also occurs.—Froeh. 59; CIL 13, 63; Kisa 946, 61.
- 95^a. **S. S. Cic.**—CIL 12, 5696, 14; Kisa, 964, 280.
96. **S. Salvi Grati.**—CIL 5, 2, 8118, 3; Kisa, 962, 253. Froeh. 41: "*Caius Salvius Gratus.*"
97. **(Ex officina) Fronti(niana) Sextin(ii).**—Froeh. 61, 67; CIL 13, 3, 2, 10025, 65, a-f; Kisa, 947, 63.
98. **Silo(?)** upside down.—Froeh. 85; CIL 13, 3, 2, 10025, 105; Kisa, 949, 101. *SSLO* and *OTIS* have also been suggested (see *Ibid.*).
99. **Silv.**—Froeh. 97; CIL 12, 5696, 15; Kisa, 964, 281.
100. **Sub.**—Froeh. 98; CIL 13, 3, 2, 10025, 96; Kisa, 949, 92.
101. **Sextus Terentius Abascantus(?).**—Froeh. 42; Kisa, 931.
102. **Ex Of(ficina) Titien(i) Hyaci(nthi).**—CIL 15, 2, 1, 6997; Kisa, 930, 39. Cf. *C. TITI ENI FAUST*, backwards, CIL 11, 2, 1, 6710, 10; Kisa, 965, 296.
103. **M? V() Nasso**—CIL 13, 3, 2, 10025, 99., or **Nasso ma(nu).**—Kisa, 949, 95.
104. **S. V() Trop(himi ?).**—CIL 13, 3, 2, 10025, 159; Kisa, 953, 153. Froeh. 86: "*Syntrophus.*"
105. **Valirmus** or **Val(e)r(ii) Muc(iani)(?).**—CIL 12, 5696, 16; Kisa, 964, 282.
106. **DV///V.**—CIL 13, 3, 2, 10025, 100; Kisa, 949, 96. Froeh. 43: "*Decimus Valerius N*"
107. **Vi().**—CIL 13, 3, 2, 10025, 101; Kisa, 949, 97.
108. **Vit().**—CIL 13, 3, 2, 10025, 102; Kisa, 949, 98.
109. **A Volumni Ianvari.**—Froeh. 44; CIL 12, 5696, 17; 13, 3, 2, 10025, 10, a-b; 15, 2, 1, 6970; Kisa, 925, 13; 940, 10; Abramić-Colnago, 80.
110. **Fo() Ze(no)nis** or **Ze(no)nis Fo(rma)(?).**—CIL 13, 3, 2, 10025, 106; Kisa, 949, 102.

b. Unexplained Signatures

1. **A.**—CIL 13, 3, 2, 11025, 127; Kisa, 951, 121.
2. **A C** above **O I** backwards.—CIL 15, 6981; Kisa, 927, 24.
3. **A E.**—CIL 13, 3, 2, 10025, 129; Kisa, 951, 123.

4. A F.—CIL 12, 5696, 24; 13, 3, 2, 10025, 71, a-c; Kisa, 947, 69. Froeh. 14: "*Quintus A . . . F . . .*" by mistake.
5. A I M.—Kisa, 948, 81.
6. AHP above O O O above A P A upside down.—CIL 13, 3, 2, 10025, 110; Kisa, 950, 105.
7. A L B.—CIL 13, 3, 2, 10025, 4.
8. A O above T A.—Froeh. 99; CIL 13, 3, 2, 10025, 22; Kisa, 941.
9. A P.—CIL 7, 1275; Kisa, 967, 309.
10. A S.—CIL 13, 3, 2, 10025, 130; Kisa, 951, 124.
11. A V.—CIL 12, 5696, 25; Kisa, 964, 286.
12. A V I.—CIL 12, 5696, 26; Kisa, 964, 287.
13. B.—CIL 13, 3, 2, 10025, 73.
14. B C backwards.—CIL 13, 3, 2, 10025, 133; Kisa, 951, 128.
15. B C C C C irregularly arranged.—CIL 13, 3, 2, 10025, 126; Kisa, 120.
16. BOR.—CIL 13, 3, 2, 10025, 134; Kisa, 951, 129.
17. B V P V.—CIL 13, 3, 2, 10025, 108.
18. C.—CIL 13, 3, 2, 10025, 74; Kisa, 947, 71.
19. C A S E.—CIL 13, 3, 2, 10025, 112; Kisa, 950, 107.
20. C C above C Q.—CIL 13, 3, 2, 10025, 113; cf. 114; Kisa, 109.
21. C C above P C.—*Kamp, Die epigraph. Anticaglien in Köln* (1869), 140; CIL 13, 3, 2, 10025, 115; Kisa, 110.
22. C C above T.—CIL 2, 1, 7000; Kisa, 930, 42.
23. C F.—CIL 13, 3, 2, 10025, 135; Kisa, 951, 127.
24. C F H and V P.—CIL 15, 2, 1, 6998.
25. C G above C P.—CIL 13, 3, 2, 10025, 116; Kisa, 950, 111.
26. C G above P C.—CIL 13, 117; Kisa, 112.
27. C M above H R.—*Kamp, Die epigraph. Anticaglien in Köln* (1869), 141; CIL 11, 2, 1, 6710, 11; 13, 3, 2, 10025, 23, a-d.
28. C P.—CIL 15, 2, 1, 6999; Kisa, 930, 41.
29. C P above C T.—CIL 13, 3, 2, 10025, 118; Kisa, 950, 113.
30. C S above C.—CIL 15, 2, 1, 6971; Kisa, 926, 14.
31. D.—CIL 13, 3, 2, 10025, 77; Kisa, 947, 74.
32. D R.—CIL 13, 3, 2, 10025, 139; Kisa, 952, 133.
33. D S.—CIL 12, 5696, 29; Kisa, 965, 290.
35. EX above C.—CIL 12, 5696, 30; Kisa, 965, 291.
36. F M above O R.—CIL 13, 3, 2, 10025, 24; Kisa, 942, 22.
37. FUR above VICT.—CIL 15, 2, 1, 6978; Kisa, 927, 21.
38. G A above T.—CIL 13, 3, 2, 10025, 131; Kisa, 951, 125.
39. G E.—CIL 13, 3, 2, 10025, 141; Kisa, 952, 135.
40. G F or C F above H I.—*Philologus* (1868), 561; *Kamp, Die epigraph. Anticaglien in Köln* (1869), 142; CIL 11, 2, 1, 6701, 12; 12, 5696, 23; 13, 3, 2, 10025, a-m; 15, 2, 1, 6984 (with G); 15, 2, 1, 6983, a-i (with C); Kisa, 927, 26.

41. G F above H C, or O, or Q.—Kisa, 928, 27; 942, 24.
42. G R above H O.—CIL 13, 3, 2, 10025, 25, a-e.
43. H F T backwards about a circle.—Froeh. 113; CIL 13, 3, 2, 10025, 31, a-f.
44. H L.—CIL 13, 3, 2, 10025, 143; Kisa, 952, 137.
45. . . INBN . .—CIL 13, 3, 2, 10025, 165. Kisa, 954, 159 (*SINBN*).
46. I A D in a circle surrounded by T L T C—Froeh. 115; CIL 13, 3, 2, 10025, 81; Kisa, 948, 78.
47. I N M.—CIL 11, 2, 1, 6710, 13; Kisa, 965, 297.
48. I O -K.—CIL 13, 3, 2, 10025, 166; Kisa, 954, 160 (O-K).
- 48^a. L E.—CIL 13, 3, 2, 10025, 145; Kisa, 952, 139.
49. LIZM above MAM.—CIL 12, 5696, 8; Kisa, 963, 274.
50. M.—CIL 13, 3, 2, 10025, 87; 147; Kisa, 948, 84; 952, 141.
51. MAC backwards.—CIL 13, 3, 2, 10025, 128; Kisa, 951, 122.
52. M C above H R or M G above H R.—Kamp, *Die epigraph. Antiquarien in Köln* (1869), 141; CIL 5, 2, 818, 4; 13, 3, 2, 10025, 28, a-c (one with G); 15, 2, 1, 6986, a-c (with G); Kisa, 928, 28 (with G).
53. M D.—CIL 13, 3, 2, 10025, 148; Kisa, 952, 142.
54. M I or T.—CIL 13, 3, 2, 10025, 88; Kisa, 948, 85.
55. M T.—CIL 13, 3, 2, 10025, 149; Kisa, 952, 143.
56. M T above C C.—Kisa, 928, 30.
57. M V.—Froeh. 110; CIL 12, 5696, 27; Kisa, 964, 288.
58. N.—CIL 13, 3, 2, 10025, 89; Kisa, 948, 86.
59. N N.—CIL 13, 3, 2, 10025, 90; Kisa, 948, 87.
60. /NNI.—CIL 12, 5696, 21; Kisa, 964, 284.
61. O B I.—CIL 13, 3, 2, 10025, 167; Kisa, 954, 161.
62. OCTA.—CIL 13, 3, 2, 10025, 152; Kisa, 953, 146.
63. O P above C F.—CIL 5, 2, 8118, 5; Kisa, 962, 254.
64. O O O above P A.—CIL 13, 3, 2, 10025, 93; Kisa, 948, 89.
65. P.—CIL 13, 3, 2, 10025, 92; Kisa, 948, 88.
66. P A above V V.—CIL 13, 3, 2, 10025, 121, a-c; Kisa, 950, 116.
67. P-V-P-V.—CIL 13, 3, 2, 10025, 109; Kisa, 949, 104.
68. Q D E above P F(?).—CIL 13, 3, 2, 10025, 138; Kisa, 952, 132.
69. REM OTRO.—CIL 13, 3, 2, 10025, 156; Kisa, 953, 150.
70. -RIMU.—CIL 7, 1276; Kisa, 966, 303.
71. S.—CIL 13, 3, 2, 10025, 95; Kisa, 999, 91.
72. SC or G.—CIL 9, 6085, 2; 11, 2, 6710, 2.
73. S C above V.—CIL 13, 3, 2, 10025, 29, 15, 2, 1, 6987; Kisa, 928, 29, 942, 27.
74. S C above A.—CIL 12, 5696, 6. Froeh. 28: "*Sextus G A*"
75. S G above A.—Kisa, 963, 272.
76. S O above V.—Froeh. 111; CIL 13, 3, 2, 10025, 30; 15, 2, 1, 6988.
77. S P S G A F.—CIL 15, 2, 1, 6973; Kisa, 926, 16.

78. **S P S C P D.**—Kisa, 926, 15.
 79. **S S.**—CIL 13, 3, 2, 10025, 122; Kisa, 950, 117.
 80. **T.**—CIL 13, 3, 2, 10025, 97; Kisa, 949, 93.
 81. **T F H.**—Kisa, 942, 29.
 82. **T M** above **.D D**—CIL 15, 2, 1, 6986.
 83. **V.**—CIL 13, 3, 2, 10025, 168. Kisa, 954, 162 (*VO///*).
 84. **VAE** above **VI.**—CIL 13, 3, 2, 10025, 160; Kisa, 953, 154.
 85. **V C** above **V C** backwards, **T** and **A** on either side.—CIL 15, 2, 1, 7003; Kisa, 930, 45.
 86. **V F.**—CIL 13, 3, 2, 10025, 158; Kisa, 953, 152.
 87. **VI C** above **CDO.**—CIL 15, 2, 1, 6974; Kisa, 926, 17.
 88. **V L.**—*Kamp, Die epigraph. Anticaglien in Köln* (1869), 138; CIL 13, 3, 2, 10025, 98; Kisa, 949, 94.
 90. **V M.**—CIL 12, 5696, 28; Kisa, 965, 289.
 92. **VOL.**—CIL 13, 3, 2, 10025, 103; Kisa, 949, 99.
 93. **VO** above **ST V.**—CIL 10, 8062, 9; Kisa, 963, 263.
 94. **V S.**—CIL 13, 3, 2, 10025, 123; Kisa, 951, 118.
 95. **Monograms and irregular and indistinct forms.**—Froeh. p. 52ff.; CIL 13, 3, 2, 10025, 12, 13, 124, 125; Kisa, 930, 46; 931, 48; 951, 119.

F. MANUFACTURING CENTERS

Natural resources greatly influenced the location of manufacturing centers. Egypt possessed both sand and *nitrum*, and it is, therefore, not surprising that the first certain mention of glass in Greek and in Latin is in connection with that country. Herodotus (*S. V*) tells of the sacred crocodiles wearing earrings of glass.¹ In the *Periplus* of Scylax (*S. IV*) glass is designated simply as the 'Egyptian stone.'² Theophrastus (*S. IV/III*) says that the Egyptians made an artificial *kyanos*,³ which has been identified with glass-paste such as that of the frieze of Tiryns.⁴ Pliny (*S. I*)⁵ speaks of an emerald colossus in the Egyptian Labyrinth, which was probably of green glass. Lucan (*S. I*)⁶ says, "A *crystallos* supplies the waters of the Nile for the hands." Martial (*S. I*) speaks of the *toreumata*⁷ of the Nile, of glass cups as the 'genius of the Nile,'⁸ and

¹ See above, p. 20, n. 2.

² See above, p. 21, n. 8.

³ See above, p. 13, n. 18.

⁴ See above, p. 14, n. 27ff.

⁵ See below, p. 143, n. 45.

⁶ See above, p. 81, n. 18.

⁷ See above, p. 109, n. 24.

⁸ See below, p. 165, n. 109.

again of the fleet of the Nile bringing *crystalla*.⁹ In a letter of the Emperor Hadrian the blowing of glass in Egypt is mentioned, while the *alassontes* referred to in the same letter were probably of glass.¹⁰ Likewise the Egyptian cups mentioned by Gallienus in a letter to Claudius probably were of glass.¹¹ Under the Emperor Aurelian a tax was put on glass brought from Egypt to Rome.¹² Even among the various kinds of darts found chiefly among the Egyptians, those made of glass also occurred.¹³ In Berthelot's collection of alchemical manuscripts,^{13a} many of which he believes have an ancient Egyptian source, we find references to glass in treatises which remind us of that country, as those of *Isis to Horos*, the *Chemistry of Moses*, the writings of *Hermes*, also mention of the Egyptian prophets, the glass of Cleopatra, and glass *ammola* like those from Alexandria.

In Egypt the chief source of materials was found in the north-western Delta, where glass works have been discovered.^{13b} Although the glass and murrine for export to the Berbers, mentioned in the *Periplus of the Red Sea* (*S.* 1), were reported to have been made at Thebes,¹⁴ there are some who question whether glass was not sent there in ingots from the northwest to be worked over.¹⁵ In repeating the description of burial in glass as given by Herodotus and Ctesias, Diodorus (*S.* I)¹⁶ adds that there was plenty of glass for all because a great deal of it was made in Aethiopia. Although the story itself is probably false (see above, page 23), at the time of Diodorus glass from that part of the world was well known. Alexandria was one of the greatest glass manufacturing centers of antiquity. Cicero (*S.* I)¹⁷ is the first to mention glass that was imported from there.

⁹ See above, p. 82, n. 19.

¹⁰ See above, p. 107, n. 41, and below p. 165, n. 114.

¹¹ See below, p. 165, n. 113.

¹² Vopisc. *Aurel.* 45: vectigal ex Aegypto urbi Romae Aurelianus vitri chartae lini stupae atque anabolicas species aeternas constituit.

¹³ Paul. Aeg. *Chirurgia*, 348: αὐτὰ τὰ βέλη . . . ὑάλινα . . . τοσαύτη γὰρ τις διαφορά μάλιστα παρ' Αἰγυπτίοις εὐρίσκεται.

^{13a} See above, p. 105, n. 31; p. 102, n. 8; below, p. 156, n. 36^a; p. 175, n. 208; p. 178, n. 227. *Collection*, 37, 1: πρόσβαλε εἰς τὴν χῶνῃν ἕλκον κλεοπατρινόν. *Hist.* I, 245.

^{13b} Newberry, *op. cit.* 157ff.

¹⁴ See above, p. 21, n. 10.

¹⁵ Dillon, *op. cit.* 25; Newberry, *op. cit.* 156ff.

¹⁶ See above, p. 25, n. 6.

¹⁷ *Pro Rabir. Post.* 14, 40: 'dominatus est enim,' inquit, 'Alexandriae' . . . fallaces quidem et fucosae e chartis et linteis et vitro velatae; quibus cum multae naves refertae fuissent, una non completa fuit parva.

And it was workmen of that city who gave Strabo (*S.* I) his information about the excellent Egyptian sand.¹⁸ Augustus is reported to have kept but a single murrine cup when he took Alexandria.¹⁹ Athenaeus (*S.* 2/3)²⁰ had heard that in Alexandria they imitated every possible kind of earthenware cup in glass. Cups of Alexandrine crystal are mentioned by Capitolinus (*S.* 4).²¹ Dillon²² writes, "We may find, perhaps, what is the last reference to Alexandria in connection with glass in 'the most precious vase, *Alexandrinī generis*,' that the Emperor Henry II (d. 1024 A.D.) presented to the Abbot of Cluny;" but Demetrius (*S.* 13)²³ mentions the use of Alexandrine glass in his own time.

The one ancient detailed account of glass ascribes its origin to the Phoenician coast, where there was excellent sand, especially along the Belus river,²⁴ and according to some at Sidon likewise.²⁵ In the early empire this city was already an important manufacturing center. Pliny calls Sidon the *artifex vitri*,²⁶ and ascribes to her the invention of the mirror of glass,²⁷ although he speaks of her process of glass making as one of an earlier day.²⁸ Lucian (*S.* 2)²⁹ uses Sidonian glass as a standard of transparency. The importance of Sidon in the field of glass making is shown by the number of workmen who signed their names as Sidonians.³⁰ Whether they worked in the East or moved to the West, they preserved the traditions of Sidon's arts. Although Tyre is not mentioned in classical literature as a glass manufacturing center, she no doubt engaged in that trade. As early as Herodotus (*S.* V)³¹ notice is taken of an emerald pillar in Tyre, which was probably of green glass made in a

¹⁸ See above, p. 98, n. 7.

¹⁹ See above, p. 90, n. 34.

²⁰ *II*, 784C: κατασκευάζουσι δέ, φησιν, οἱ ἐν Ἀλεξανδρείᾳ τὴν ὕαλον μεταρρυθμίζοντες πολλαῖς καὶ ποικίλαις ἰδέαις ποτηρίων, παντὸς τοῦ πανταχόθεν κατακομιζομένου κεράμου τὴν ἰδέαν μιμούμενοι. See above, n. 13a.

²¹ See above, p. 91, n. 35.

²² *Op. cit.* 149, n. 2.

²³ See below, p. 181, n. 19.

²⁴ See above, p. 95, n. 4; p. 97, n. 3.

²⁵ See above, p. 98, n. 6.

²⁶ *N. H.* 5, 76.

²⁷ See above, p. 102, n. 3.

²⁸ See above, p. 102, n. 3-4.

²⁹ *Amores*, 26: τὸ δ' ἄλλο σῶμα μὴ δ' ἀκαρῇ τριχὸς αὐταῖς ὑποφνομένης ἡλέκτρον, φασίν, ἥ Σιδωνίας ὑέλου διαφεγγέστερον ἀπαστράπτει.

³⁰ See above, p. 115.

³¹ See below, p. 142, n. 43.

local factory. William of Tyre³² (*S.* 12) speaks of local sand for the manufacture of glass in his native city, the various, beautiful, transparent vessels of which have brought not only fortunes to merchants but also renown to the name of Tyre among all foreign nations. In the same century Benjamin of Tudela says that the Jews had control of the 'far-renowned Tyrian glass.'³³ He also mentions the manufacture of glass at Antioch.³⁴ The eastern methods, no doubt, spread to Carthage³⁵ and Mauretania.^{35a}

Stories of the manufacture of glass in the far East are less trustworthy. Pliny praises most highly the glass of India which, he says, was made of broken crystal. However, it is doubtful if glass was then made in India.³⁶ When Propertius^{36a} writes of 'murrine cups baked in Parthian ovens,' it may be no more than a poetical way of saying that they came from the near East, and, if so, the expression would indicate that the manufacture of glass had by the first century spread from Phoenicia as far as Mesopotamia.

In the time of Strabo very clear, crystal-like glass was being manufactured at Rome. This glass was very cheap in price.³⁷ In the first region, which lay between the Aventine and Caelian, there was a *vicus vitrarius*,³⁸ the exact location of which is not known.³⁹ A fragmentary piece of marble from an unknown locality seems to refer to a 'portico among the glass workers.'⁴⁰ It was in speaking of the fine white sand of Volturnus that Pliny gave his description

³² *Hist. des Croisades*, 2, 54, 13, (Guizot, 1824): On fait aussi merveilleusement, avec un sable qui se trouve dans la même plaine, la plus belle qualité de verre, qui sans aucun doute, occupe le premier rang parmi les produits de la même espèce. Ce verre, transporté de là dans les provinces les plus éloignées, fournit la meilleure matière pour faire des vases de la plus grande beauté, remarquables surtout par leur parfaite transparence. Ces diverses productions ont rendu le nom de la ville de Tyr célèbre chez toutes les nations étrangères, et fournissent aux négocians les moyens de faire des fortunes considérables.

³³ See above, p. 117, n. 22.

³⁴ See above, p. 118, n. 23.

³⁵ See above, p. 114, n. 12.

^{35a} See above, p. 114, n. 11.

³⁶ See above, p. 98, n. 10 ff.

^{36a} See above, p. 85, n. 6.

³⁷ See above, p. 55, n. 13. Henrivaux, *Le Verre et le Cristal* (1897), 1, was evidently unfamiliar with Strabo's account when he ascribed the establishment of the first glass factory in Rome to Nero.

³⁸ *Reg. Urb. Reg.* 1, 3, 5 (*Curios. Urb. Reg.* 1, 2, 5) in Urlichs, *Cod. Urb. Rom. Top.* (1871): Regio I. Porta Capena . . . vicum vitrarium.

³⁹ Huelsen, *Topogr. d. St. Rom* 1, 3 (1907), 219.

⁴⁰ CIL 6, 29844 (=93): P|orticus? Inter Vitrarios?

of the process of making glass.⁴¹ In Puteoli there was a *clivus vitriarius*,⁴² which must certainly mean that glass was made there. In fact representations of the harbor of Puteoli with its buildings have been found on glass flasks⁴³—products, no doubt, of a local factory. The name of the town Vitricium,⁴⁴ modern Verres,⁴⁵ may have nothing to do with *vitrum*, but it is conceivable that as the knowledge of glassmaking spread to the provinces, a factory was established in northern Italy and the town received its name from its principal industry.⁴⁶

In the provinces of Gaul and Spain, according to Pliny,⁴⁷ glass was made in the same way as in the vicinity of Cumae. But Strabo does not speak very highly of the glass which the Britons imported from Gaul.⁴⁸ How early the Britons began to make their own glass is uncertain.^{48a} In 675, because the art of making glass was unknown in England, Benedict, bishop of Wearmouth, introduced glassmakers from Gaul to decorate his church. These glassmakers also instructed the Britons in their art,^{48b} but in less than a century an abbot of Wearmouth wrote to the archbishop of Mainz asking for a glassmaker because the art of glass making was unknown in his region.^{48c} Glastonia, mentioned in a work of the twelfth century, might

⁴¹ See above, p. 102, n. 4.

⁴² Dessau, *Inscr. Lat.* I, 1224b: Mavortii | Q. Flavio Maesio Egnatio Lolliano | c. v., q. k., praetori urbano, auguri pu | blico populi Romani Quiritium, cons. | albei Tiberis et cloacarum, cons. operum | publicum, cons. aquarum, cons. Camp., | comiti Flaviali, comiti primi | ordinis et proconsuli provinciae Africae | regio clivi vitriari sive vici turari | patrono dignissimo.

⁴³ CIL 2, Suppl. 6251; Kisa, *op. cit.* 640 f.; 932, 50.

⁴⁴ *Itin. Ant.* (Parthey-Pinder (1848)). De Italia in Gallias. Item a Mediolano per Alpes Graias. 345, 2: Vitricum m p m XXI (Cod.: vitritium C, vitridium JLN XX R). 347, 5: Vitricium m p m XXXIII (Cod.: vitritium CR). 351, 2: Item a Mediolano per Alpes Penninas. Vitrico m p m XXI (Cod.: vitritio C, vitracio OQ, vitricia P).

⁴⁵ Graesse, *Orb. Lat.* ed. 2 (1909), 317; Böcking, *Notitia Dignitatum et Administrationum* (1839–1853), 1131. The town is north of Milan in the Alps.

⁴⁶ Cf. above, p. 40, n. 46^a; p. 42, n. 8^a–9; p. 46, n. 42; below, n. 48^d, 53; also Glassboro, New Jersey, where one finds the oldest glass factory in the United States that is still operating; see Walbridge, *American Bottles Old and New* (1920), 12, 13; Moore, *op. cit.*, 217; Van Rensselaer, *op. cit.*, 120, 134.

⁴⁷ See above, p. 102, n. 4.

⁴⁸ 4, 5, 3: καὶ ὑαλὰ σκεύη καὶ ἄλλος ῥῶπος τοιοῦτος.

^{48a} There are some who believe that early glazed beads were indigenous to Britain; see Evans, *The Palace of Minos*, (1921), 493, n. 6.

^{48b} See above, p. 113, n. 7b.

^{48c} See above, p. 114, n. 7c.

have derived its name from the manufacture of glass there, possibly in Roman days.^{48d} The signatures of several glass workers occur chiefly in Gaul,⁴⁹ especially signatures from the factory of Frontinus.⁵⁰ Possibly the letters *C A* above *C* and *A* upside down, found on vessels in the northern provinces, stand for C(olonia) C(laudia) A(grippinensis) A(ugusta); if so, these stamps are the only literary record of what archaeology shows to have been one of the most important of all centers.⁵¹ Aside from glass factories which have been discovered,⁵² and localities which retain names derived from their early glass factories,⁵³ one of the particular places where glass was made was Lugdunum, to judge from a sepulchral inscription found there of a glass worker from Carthage.^{53a} An inscription of a glass worker has also been found in Dalmatia.⁵⁴

Although the Greeks were familiar with glass and prized it from very early times, there is no reference in classical literature to the manufacture of glass in Greece. A sepulchral inscription of a glass worker was found in Athens.⁵⁵ In later times we are told that glass was made in Thessalonica.⁵⁶ Theophilus^{56a} speaks familiarly of Greek glass. The glass workers of Constantinople, no doubt, enjoyed the

^{48d} Caradocus Lancarbanensis, *Vita Gildae*, in *Chron. Min.* (ed. Th. Mommsen) *Mon. Germ. Hist. Auct. Antiqu.* 13 (1898), 109, 10: Glastonia, id est Urbs Vitren, quae nomen sumsit a vitro, est urbs nomine primitus in Britannico sermone . . . 110, 14: Ynisgutrin nominata fuit antiquitus Glastonia et adhuc nominatur a Britannis indigenis: ynis in Britannico sermone insula Latine; gutrin vero vitrea. sed post adventum Angligenarum et expulsis Britannis, scilicet Walensibus, revocata est Glastiberi ex ordine primi vocabuli, scilicet glas Anglice vitrum Latine, beria civitas, inde Glastiberia id est Vitrea Civitas.

⁴⁹ See references to CIL 13, above, p. 120ff.; Thédénat *Rev. de Philol.* 11 (1887), 55; Dillon, *op. cit.*, 88; Nesbitt, *op. cit.* 96; Kisa, *op. cit.* 726ff., 936ff.; Jullian, *Hist. de la Gaule*, 5 (1920), 295.

⁵⁰ See above, p. 123, no. 47.

⁵¹ Kisa, *op. cit.* 938.

⁵² A. K. *Rev. de Philol.* 6 (1882), 40; 39 (1915), 114; Hettner, *Id.* 10 (1895), 211; Colson, *Rev. Archéol.* 1 (1903), 277; Jullian, *Rev. des Études Anc.* 23 (1921), 330; Bümlein, *Bursian's Jahresbericht*, 197 (1923), 94.

⁵³ Gerspach, *op. cit.* 18: "Mais il y a présomption que des fabriques se trouvaient en Normandie et certitude qu'il y en avait en Poitou; dans ce pays, certaines localités ont été longtemps désignées sous les noms de verraria, vitrerea, portus vitrarie et, a côté de débois de terre, on a trouvé des scories."

^{53a} See above, p. 114, n. 12.

⁵⁴ See above, p. 115, n. 14.

⁵⁵ See above, p. 114, n. 10.

⁵⁶ Dillon, *op. cit.* 96.

^{56a} 2, 13-15.

exemptions of the Theodosian Code.⁵⁷ From Byzantine times there are a number of references to glass workers, especially Jews,⁵⁸ and to their factories,⁵⁹ which gave their name to one of the gates of the city.⁶⁰

G. EVIDENCE FOR THE IMPORTANCE OF THE TRADE

In Greek and Latin there is no reference to the manufacture of glass in ancient Greece, with the exception of the glass maker at Athens in Christian times.¹ As a foreign product, its nature was not sufficiently understood to prevent it from being confused with other substances.² At first it was a rarity in Greece, and its value among other peoples is shown by its classification with precious metals and its use by those of high rank. Possibly the author (*S. VI/II?*)^{2a} and at least the translators of the Book of Job³ in praising wisdom say that 'gold and glass cannot equal it,' and list glass with gold, silver, onyx, sapphire, coral, crystal, topaz, and rubies. Aristophanes (*S. V*)⁴ speaks of the use of glass and gold cups at the Persian court. Theophrastus (*S. IV/III*) says that it was known which Egyptian king first made artificial *kyanos*.⁵ He also tells of a Babylonian king who was reported to have sent to Egypt an emerald so large that he questions its genuineness.^{5a} It was probably of green glass.^{5b} Glass had its place at the banquet of Ptolemy Philadelphus (*S. III*)⁶ In Epinicus (*S. III*)⁷ king Seleucus is represented as drink-

⁵⁷ See above, p. 119, n. 34.

⁵⁸ See above, p. 113, 117.

⁵⁹ See above, p. 119, n. 38.

⁶⁰ Gerspach, *op. cit.* 81; Dillon, *loc. cit.*

¹ See above, p. 114, n. 10.

² See above, p. 23ff.

^{2a} Cheyne and Black, *Encyclopedia Biblica*, 2 (1901). s. v. Glass: "Zēkūkīth, . . ., √ 'clear' [transparency is not implied], *A. V.* 'Crystal,' *R. V.* 'Glass'; ὑαλος [BNAc]." See Hastings, *A Dict. of the Bible* (1902) and *The Jewish Encyclopedia* (1903), s. v. Glass, also Kisa, *op. cit.* 96. The precious nature of the substance is also evident in *The Book of Enoch*, see below, p. 141, n. 29^a.

³ 28, 17: οὐκ ἰσωθήσεται αὐτῇ χρυσίον καὶ ὑαλος. *Vulgate*: non adaequabitur ei aurum vel vitrum.

⁴ *Ach.* 74: ξενιζόμενοι δὲ πρὸς βίαν ἐπίνομεν ἐξ ὑαλίνων ἐκπωμάτων καὶ χρυσίδων ἄκρατον οἶνον ἡδύν.

⁵ See above, p. 12ff.

^{5a} See below, p. 143, n. 44.

^{5b} See below, V, B, a.

⁶ See below, p. 154, n. 23.

⁷ See above, p. 20, n. 4.

ing from a goblet of molten stone, i. e., glass. However, as early as the fifth century B.C., glass was sufficiently familiar to be used as a standard of comparison for transparent objects.⁸ In the fourth century Pausias painted a picture of a figure drinking out of a cup of highly transparent glass.⁹ The word for glass, especially in its adjectival forms, continued to be used, in describing the numerous objects made of it¹⁰ and as a standard of comparison,¹¹ until modern times.¹²

Yet it was not until the beginning of the Roman empire that we know much about glass. Strabo (*S.* I)¹³ gives the first information of any detail about its manufacture in Egypt, Sidon, Rome, and Gaul; then comes Pliny's¹⁴ history of glass (*S.* 1), which is the only one in antiquity with the exception of portions of Isidore's *Origines* (*S.* 6/7),¹⁵ and Rabanus Maurus' chapter on glass (*S.* 9)¹⁶ that only follow the *Natural History*. Pliny not only tells of the traditional origin, the methods and places of manufacture, but he also describes valuable imported pieces. Since the Romans had their own factories, it is not strange to find their writers, especially the poets of the first and following centuries frequently mentioning glass.¹⁷ The adjective also was employed very often to express transparency, brightness, clearness, and possibly greenness.^{17a}

There is some evidence that the Romans found the process of making glass difficult and expensive. There seems to have been a rather extensive trade in old glass, which was probably remelted to save the process of fusion.¹⁸ Again, we read that the vessels of crystal glass increased in price and did not bring down the value of real crystal,¹⁹ indicating that their output must have been rather

⁸ See above, p. 33.

⁹ Paus. 2, 27, 3: γέγραπται δὲ ἐνταῦθα καὶ Μέθη, Πανσίου καὶ τοῦτο ἔργον, ἐξ ὑαλίνης φιάλης πίνουσα· ἴδους δὲ κἂν ἐν τῇ γραφῇ φιάλην τε ὑάλου καὶ δι' αὐτῆς γυναικὸς πρόσωπον.

¹⁰ See below, p. 138ff.

¹¹ See above, p. 33ff.

¹² See above, p. 37, n. 29.

¹³ 16, 758.

¹⁴ *N. H.* 36, 190ff.

¹⁵ *Orig.* 16, 16.

¹⁶ *De Universo*, 17, 10.

¹⁷ See above, p. 62ff.

^{17a} See above, p. 66ff.

¹⁸ See above, p. 106f.

¹⁹ See above, p. 79.

small. From other sources, however, come indications that by the beginning of our era glass was becoming very common and cheap. In some ways glass was used more extensively in antiquity than today, and Winckelmann^{19a} considers that it reached a higher artistic development among the ancients. It was used in imitating almost every kind of gem;²⁰ with the exception of the modern glass windows and mirrors it was probably employed to a greater extent in interior decoration in antiquity;²¹ pottery of every form was imitated in glass;²² and it competed with the precious metals for table, toilet, and other household uses,²³ many of which are supplied today by porcelain. Strabo²⁴ speaks of the cheapness of glass in Rome, and Trimalchio in expressing his preference for glass is made to bring out the same fact.²⁵ Yet in spite of the fact that some glass was common and cheap, there were still objects of it which could be classed with the precious metals. The wealthy and noble might yet prize the unusual pieces as extremely valuable. As has been noted Augustus kept nothing but a murrine cup when Alexandria was taken.²⁶ In the first century we come across the fabulous story of the making of malleable glass; the Emperor Tiberius is said to have put its inventor to death to prevent the value of the precious metals from being lessened.²⁷ But Pliny tells us that "for drinking-vessels, glass has quite superseded the use of gold and silver."^{27a} Nero possessed a number of rare pieces of glass which he valued highly.²⁸ Chryse, a wealthy woman of the third century, is said to have been so called because she used only vessels of gold, never of silver or glass.²⁹ The Emperor Gallienus about the same period always used gold likewise; he despised glass because it was so common.³⁰ But a few years later the Emperor

^{19a} *Werke*, 3 (1809), 39.

²⁰ See below, p. 144ff.

²¹ See below, p. 138ff.

²² See above, p. 130, n. 20.

²³ See below, p. 150ff.

²⁴ See above, p. 55, n. 13.

²⁵ Petron. 50: *ignoscetis mihi, quod dixero: ego malo mihi vitrea, certe non olunt. quid si non frangerentur mallet mihi quam aurum; nunc autem vilia sunt.*

²⁶ See above, p. 90, n. 34.

²⁷ See above, p. 110, n. 36ff.

^{27a} See above, p. 80, n. 5.

²⁸ See above, p. 79, n. 3; p. 87, n. 14; below, p. 156, n. 35; p. 166, n. 117; p. 119, n. 119-120.

²⁹ See below, p. 162, n. 80.

³⁰ See below, p. 155, n. 25.

Tacitus expressed his approval of elaborately wrought glass cups.³¹ Thus, while glass continued to lend itself more and more to the ordinary household uses, its favor among the wealthy suffered from or profited by the changing whims of fashion or individual taste.

In regard to foreign trade, mention has already been made of the use of glass by the Egyptians^{31a} in trading with the West Africans^{31b} (*S. IV*) and peoples about the Red Sea (*S I*)³². The diversity of localities in which glass signed by Sidonians is found³³ is evidence of the extent of their trade. The works of Ennion alone, who was probably from Sidon or nearby, have been found in numerous spots in Northern Italy, Sicily, Cyprus, and the Bosphorus.³⁴ Signatures on glass also show that the Gauls had extensive factories, from which they probably sent their exports to Britain.³⁵ We do not read of Rome exporting glass, but she did import it, especially from Egypt.³⁶ Since Rome herself produced quantities of excellent glass, that imported was probably only of exceptionally fine workmanship. The Church naturally condemned such luxuries.³⁷ The importance of the industry was sufficient to induce the Roman government to raise revenues by taxing glass-workers³⁸ and by levying a duty on imported wares;³⁹ to grant the workers in glass, as artists who deserved a special consideration, certain exemptions;⁴⁰ and to regulate the location of glass factories.⁴¹

³¹ See below, p. 154, n. 24.

^{31a} This foreign trade is shown to be of great antiquity by the finds of archaeologists. In speaking of the trade in faïence beads carried on by Crete with Egypt and the West, Sir Arthur Evans, *The Palace of Minos* (1921), 493, says, "The chronological limits of this intercourse would be between the beginning of the sixteenth century B.C., the date of the Temple Repositories at Knossos, and the close of the Minoan era proper, about 1200 B.C. The later intercourse, however, during the L. M. III Period, was probably the work rather of the Mainland Mycenaean branch than of traders from Minoan Crete."

^{31b} See above, p. 21, n. 8.

³² See above, p. 21, n. 10.

³³ For a chart of localities, see West, *op. cit.* 175.

³⁴ Kisa, *op. cit.* 708ff.

³⁵ See above, p. 132, n. 48.

³⁶ See above, p. 128ff. See Eisen (*Art and Archaeol.* 6 (1917), 76).

³⁷ See below, p. 109, n. 24; p. 170, n. 156.

³⁸ See above, p. 118, n. 32.

³⁹ See above, p. 119, n. 33.

⁴⁰ See above, p. 119, n. 34.

⁴¹ See above, p. 119, n. 38.

V. THE USES OF GLASS AS RECORDED IN LITERATURE

The recorded uses of glass will be arranged, as far as seems practicable, in a roughly chronological order. At first came objects, chiefly ornaments, in the flat, molded from a paste and later from clouded glass. Then comes the revolutionizing influence of the invention of blowing glass. Straightway, the manufacture of hollow ware, especially of drinking vessels, becomes of great importance. The perfection of transparent glass made objects of it very valuable. Finally, involving a technique even more difficult than that of blowing glass, a process was discovered for making large sheets of glass which were used principally in windows.

A. ADORNMENT OF BUILDINGS

1. *Walls.* Archaeology can reveal many things about the early history of glass concerning which literature is silent. Faïence, glaze, and glass paste, often blue in color,¹ were known to the Egyptians from very early times.² In the ruins of Nineveh and Babylon glass is discovered,³ and the enameled bricks of the East⁴ show a high development of this art there as well as in Egypt. The Cretans probably established their own faïence factories⁵ through Egyptian influence.⁶ The earliest objects of manufacture were glazed or faïence beads or other trinkets for personal adornment, and in Late Minoan and Mycenaean times moulded paste gems, plaques, and other objects were also made.⁷ How highly these were esteemed

¹ Laurie, McIntock, and Miles (*Proceedings of the Royal Society of London*, 89 (1914), 418-429) give a review of the experiments of various workers on *Egyptian Blue* and their own opinion of the composition of the substance, which Sir Arthur Evans considers the "classical 'kyanos'" (see above, p. 14, n. 32).

² See above, p. 95, n. 1.

³ Layard, *Discoveries among the Ruins of Nineveh and Babylon* (1853), 196, 197, 503, 593, 597.

⁴ Perrot-Chipiez, *op. cit.* 5 (1890), 553-556, 816-822, 834ff., 872ff.

⁵ Sir Arthur Evans, *The Palace of Minos* (1921), 486.

⁶ *Op. cit.* 488.

⁷ *Op. cit.* 490. *Idem* (*Jour. of Hellen. Studies*, 21 (1901), 117); Dumont-Chaplain, *Les Ceramiques de la Grèce Propre*, 1 (1881), 59, 61; Bates (*Amer. Jour. Archaeology* 14 (1910), 109); Dussaud, *Les Civilisations Préhelléniques*, ed. 2 (1914), 177; Hall, *Aegean Archaeology* (1915), 17, 82ff., 105, 115; Glotz (*Rev. des Études Grec.* 28

may be judged from their frequent occurrence with other precious objects in graves or temples in widely separated regions.⁸ Besides its use in personal adornments, a form of glass occurs in the decoration of larger objects, as the royal gaming board at Knossos and a similar one, probably of Cretan importation, found in the fourth shaft grave at Mycenae.⁹ With a picture of the rosettes, medallions, and outlines of these gaming boards in mind, it is not difficult to conceive of their use as a covering for other objects about a palace, even in the decoration of the walls of the palace itself.¹⁰ It is just at this point that Greek literature begins to record the uses of glass.

In Homer we have noted the use of *kyanos*, which is here probably a blue glass paste,¹¹ in the frieze of Alcinous' palace,¹² in the decoration of tables¹³ and armor.¹⁴ The use of glass, especially the paste, in mural decorations¹⁵ has been observed in many places during many centuries, but in classical antiquity it is not mentioned again in literature until the time of Pliny.¹⁶ Here we probably have to do with a new type of glass wall decoration; instead of the glass paste of Homer's time perhaps glass in large slabs or smaller mosaic pieces was used.¹⁷ The middle section of the stage of the temporary theatre of Scaurus, built in the first century before Christ, was said

(1915), 440); *Jahrb. des k. d. Archaeol. Inst.* 32 (1917), 31; Herford, *The Year's Work in Class. Studies* (1918-1919), 59; Fimmen, *Die Kretisch-Mykenische Kultur* (1921), 144. At Munich there is a "Blaue Mykenische Glaskette" in the Alte Pinakothek, "Museum Antiker Kleinkunst."

⁸ See below, p. 149, n. 35.

⁹ Evans, *op. cit.* 486. See above, p. 14ff., n. 32-32a.

¹⁰ See above, p. 14, n. 30.

¹¹ See above, p. 14ff.

¹² See above, p. 11, n. 1.

¹³ See above, p. 11, n. 2.

¹⁴ See above, p. 11, n. 3-5.

¹⁵ See above, p. 18, n. 30. Compare also Haussoulier (*Bull. de Corresp. Hellén.* 2 (1878), 192; pl. 15, 2); Froehner, *op. cit.* 15; Angellier, *Rev. de Philol.* 4 (1880), 248; Perrot-Chipiez, 1 (1882), 824; Müller, *Die gr. Staats-, Kriegs- und Privataltertümer (Handb. d. Klass. Altertumswissenschaft, 4, 1 (1887), 348)*; Evans (*Four. of Hellen. Stud.* 21 (1901), 117); Jolles (*Jahrb. des Arch. Inst.* 19 (1904), 36); Dillon, *op. cit.* 53; Blümner, *Glas (P.-W.* 7 (1910), 1835); Schröder (*Jahrb. des Arch. Inst.* 34 (1919), 108ff.

¹⁶ *N. H.* 36, 114: M. Scauri . . . theatrum hoc fuit . . . una pars scaenae e marmore fuit, media e vitro, inaudito etiam postea genere luxuriae, summa e tabulis inauratis. This temporary theater was built in Rome by Scaurus during his Aedileship in 58 B.C. See Middleton, *The Remains of Ancient Rome*, 2 (1892), 62 ff.

¹⁷ Gerspach, *La Mosaïque* (1881), 11; Dillon, *op. cit.* 54.

to be of glass, a piece of luxury which calls forth severe condemnation. Pliny¹⁸ writes, "Mosaic pavements were first introduced in the time of Sulla; at all events, there is still in existence a pavement, formed of small segments, which he ordered to be laid down in the temple of Fortuna, at Praeneste. Since his times these mosaics have left the ground for the arched roofs of houses, and they are now made of glass. This, however, is but a recent invention; for there can be no doubt that when Agrippa ordered the earthenware walls of the hot baths, in the Thermae which he was building at Rome, to be painted in encaustic, and had the other parts coated with stucco, he would have had the arches decorated with mosaics in glass, if the use of them had been known; or at all events, if from the walls of the Theatre of Scaurus, where it figured, as already stated, glass had by that time come to be used for the arched roofs of apartments." According to Seneca (*S.* 1)¹⁹ "a person feels poor and base . . . unless his vaulted ceiling is covered with glass." Evidently Pliny was not wrong when he said that Agrippa would have used glass decoration in his baths if the style had been introduced, for Statius (*S.* 1)²⁰ speaks of such a use in the baths of Claudius. Perhaps in derision of such luxuries Lucian (*S.* 2)²¹ in describing the land of the blessed reports that "their baths are large glass houses, heated with cinnamon." The wealth of Firmus^{21a} became notorious, "for," as Vopiscus (*S.* 4)²² relates, "he is said to have built his house out of blocks of glass joined by bitumen

¹⁸ *N. H.* 1, 36, 64: quando primum camerae vitreae. 36, 189: lithostrota coeptavere iam sub Sulla; parvolis certe crustis exstat hodieque quod in Fortunae delubro Praeneste fecit. pulsa deinde ex humo pavimenta in camaras transiere vitro. novicium et hoc inventum; Agrippa certe in thermis, quas Romae fecit, figlinum opus encausto pinxit in calidis, reliqua albario adornavit, non dubie vitreas facturus camaras, si prius inventum id fuisset aut a parietibus scaenae, ut diximus, Scauri pervenisset in camaras. quam ob rem et vitri natura indicanda est. Translation by Bostock and Riley. See Schulten (*Jahrb. des Arch. Inst.* 18 (1905), 92ff.)

¹⁹ *Epist.* 86, 6: pauper sibi videtur ac sordidus . . . nisi vitro absconditur camera.

²⁰ *Silv.* 1, 5, 42: effulgent camerae, vario fastigia vitro | in species animoque nitent.

²¹ *Ver. Hist.* 2, 11: λουτρά δὲ ἐστὶν αὐτοῖς οἴκοι μεγάλοι ὑάλινοι, τῷ κινναμῶμῳ ἐγκαυόμενοι.

^{21a} Firmus was a native of Seleucia, S. Syria, a man of great wealth. He captured Alexandria, but was later defeated and put to death at the command of the Emperor Aurelian.

²² *Firm.* 3, 2: de huius divitiis multa dicuntur. nam vitreis quadraturis bitumine aliisque medicamentis insertis domum instruxisse perhibetur. Marquardt, *op. cit.* 738: "Als blosser Ornament erwähnt."

and other plasters." Although Du Cange²³ regarded the glassy veil mentioned in Fridegodus (*S.* 12)²⁴ as a glass window, it is more likely to have been a wall decoration or veneer. The same question²⁵ arises over the passage where Prudentius (*S.* 4) compares the arches of Saint Paul's to "meadows resplendent with the flowers of spring."²⁶ Sidonius (*S.* 5) also mentions the use of green glass in a church of Patiens.²⁷ An anonymous writer²⁸ on Sancta Sophia (*S.* 10 or earlier) speaks of the bright gold-colored glass so common in the interior decoration of early churches.²⁹ Possibly these elaborate glass mosaics were the foundation of the vision described in *The Book of Enoch* (*S.* II),^{29a} of the crystal palace of God, and in *The Life of Saint Macarius* of a church which seemed to be entirely of crystal.^{29b}

2. *Floors.* Closely connected with the use of glass mosaics for mural decoration is their employment in pavements. The only

²³ *Gloss. Med. et Infim. Lat. s. v. hyalinum velum*: "Vitrea fenestra, a Graeco ὑάλινος, vitreus."

²⁴ See above, p. 58, n. 12.

²⁵ Du Cange, *s. v. hyalinum*; Labarte, *The Handbook of Arts* (1855), 66; Dressel, *Aurel. Prud. Clem. quae extant Carm.* (1860), note on *Perist.* 12, 53; Wallace-Dunlop, *op. cit.* 166.

²⁶ See above, p. 57, n. 7.

²⁷ *Epist.* 2, 10, 4, 15 (11): distinctum vario nitore marmor | percurrit cameram solum fenestras, | ac sub versicoloribus figuris | vernans herbida crusta sapphiratos | flectit per prasinum vitrum lapillos. See Le Blant, *Inscr. Chrét. de la Gaule*, 1 (1856), 54.

²⁸ See above, p. 110, n. 32.

²⁹ See Theophilus, 2, 12, 15; Muratori *op. cit.* 363; Gerspach, *La Mosaïque* (1881), 239ff.; Wulff, *op. cit.* 314ff.; Lethaby-Swainson, *The Church of Sancta Sophia Constantinople* (1894), 172, 273.

^{29a} 14, 9: καὶ εἰσῆλθον μέχρις ἡγγισα τείχους οἰκοδομῆς (E=οἰκοδομημένου) ἐν λίθοις χαλάξης καὶ γλώσσαις (MS. γλώσσης) πυρὸς κύκλω αὐτῶν· καὶ ἤρξαντο ἐκφοβεῖν με. 10. καὶ εἰσῆλθον εἰς τὰς γλώσσας τοῦ πυρός, καὶ ἡγγισα εἰς οἶκον μέγαν οἰκοδομημένον ἐν λίθοις χαλάξης καὶ οἱ τοῖχοι τοῦ οἴκου ὡς λιθόπλακες, καὶ πᾶσαι ἦσαν ἐκ χιόνος (E=ἐν λίθοις τοῖς ἐκ χιόνος), καὶ ἐδάφη χιονικά. 18. ἐθεώρουν δὲ καὶ εἶδον (E adds ἐν αὐτῷ) θρόνον ὑψηλόν (g m q of E=ὑψηλοῦ), καὶ τὸ εἶδος αὐτοῦ ὡσεὶ κρυστάλλινον. Charles, *The Book of Enoch*, ed. 2 (1912), 33f., translates: "9. And I went in till I drew nigh to a wall which is built of crystals and surrounded by tongues of fire: and it began to affright me. 10. And I went into the tongues of fire and drew nigh to a large house which was built of crystals: and the walls of the house were like a tessellated floor (made) of crystals, and its ground work was of crystal. . . . 18. And I looked and saw therein a lofty throne: its appearance was as crystal."

^{29b} *Patr. Lat.* 73, 415: vidimus ante nos ecclesiam, mirabili ornatu decoratam, ac pretiosissimam, quae tota quasi crystallina videbatur.

mention of this use, however, is in a rather uncertain passage in the Greek anthology.³⁰

Although the vision of "streets of pure gold like transparent glass"^{30a} may not have been influenced by the author's familiarity with mosaic floors, as Cook³¹ says, in speaking of the various references to glass in the Apocalypse, "we are reminded of the Arabian legend that Solomon prepared in his Palace a glass pavement which the Queen of Sheba mistook for water (Qoran, *Sur.* 27)." The authors of *The Book of Enoch* (*S.* II) seem to have been familiar with such floors,³² which early came into use.³³

3. *Tables.* In Homer we read of a table with feet of *kyanos*.³⁴ Here too it is a long step before such decoration is mentioned again. Pliny³⁵ says that soon after the introduction of *murrina* the material was used for *abaci* which are explained as 'tables' by some.³⁶ Martianus Capella (*S.* 5)³⁷ describes a "table colored by a sprinkling of glass dust." The lexicographers defined *elektron* as a mixture of gold and glass,³⁸ which may very well have been true in their time, although the electrum of early times was something very different.³⁹ Suidas (*S.* 10) and Zonaras (*S.* 12) add that there was a table in Sancta Sophia of this substance.⁴⁰ We hear too of a table of emerald glass.⁴¹ *Tabula Smaragdina* also had a symbolic meaning.⁴²

4. *Columns.* Herodotus (*S.* V)⁴³ visited the temple of Hercules

³⁰ *Anth. Pal.* 14, 52 (51): νῦν δὲ με Μοῦσα τρίτῃ πυρίναις Νύμφαισι μιγέμεντα | δέρεται ὑελίνῳ κείμενον ἐν δαπέδῳ. Here Grotius remarks: "Intellige vitreum vas," but Paxon quite correctly translates: "But now the third sense sees me mixed with fiery nymphs lying on a pavement of glass."

^{30a} See above, p. 65, n. 13.

³¹ Cheyne and Black, *Encyclopaedia Biblica* 2(1901), s. v. *Glass*.

³² See above, n. 29a.

³³ Bosanquet (*Jour. of Hellen. Studies*, 18 (1898), 66ff.)

³⁴ See above, p. 11, n. 2.

³⁵ See above, p. 87, n. 14.

³⁶ Mau (*P.-W.* 1 (1894), s. v. *abacus*, 4): "Prunktisch zur Schaustellung von Gefässen." Bannier (*Thes. Ling. Lat.* 1 (1900), s. v. *abacus*): "Mensa preciosa ad cenas lautas et sim. adhibita."

³⁷ See above, p. 58, n. 10.

³⁸ See above, p. 31, n. 44.

³⁹ Blümner, *P.-W.* s. v. *Elektron*.

⁴⁰ See above, p. 52, n. 44.

⁴¹ Berthelot, *Origines*, 223.

⁴² Kriegsmann-Dorne (Manget, *Bibl. Chem.* 1, 380): "Ecce tibi, Amice Lector, Tabulam Hermetis Trismegisti Smaragdinam quam suo merito symbolum universi Chemicorum coetus dixeris." See *Idem*, p. 381 ff.

⁴³ 2, 44: καὶ ἐν αὐτῷ ἦσαν στήλαι δύο, ἡ μὲν χρυσοῦ ἀπέφθου, ἡ δὲ σμαράγδου λίθου λάμποντος τὰς νύκτας μέγαθος (μέγα φῶς Reiske).

in Tyre, and found in it "two pillars, one of refined gold, the other of a large emerald that shone by night." Theophrastus (*S.* IV/III)⁴⁴ had heard of a Babylonian king who sent to Egypt an emerald four cubits long and three wide, also of an obelisk of four emeralds in the temple of Jupiter, but he raised the question whether such reports were to be believed, for he considered the actual gem small and rare. He also suggested that the emerald in the temple of Hercules at Tyre, the largest on record, might not be a real emerald. Pliny refers to this passage and adds on the authority of Apion that there was a "colossus of Serapis in the Egyptian Labyrinth, nine cubits tall, made of emerald."⁴⁵ In another passage Pliny speaks of the numerous methods of imitating emeralds, but refuses to transmit them to posterity.⁴⁶ This fact added to Theophrastus' well founded doubt and our own knowledge of the size of genuine emeralds found in modern times, makes it impossible to believe in such large stones in antiquity, which can, accordingly, have been nothing else than green glass,⁴⁷ for such glass columns did actually exist, since Clemens (*S.* 1) (in the translation of Rufinus)⁴⁸ tells of enormous columns of glass (*vitreae columnae*) on the island of Aradus visited by Peter and later by himself.

⁴⁴ *De Lap.* 4, 24ff.: ἔστι δὲ σπανία καὶ τὸ μέγεθος οὐ μεγάλη, πλὴν εἰ πιστεύειν ταῖς ἀναγραφαῖς δεῖ ὑπὲρ τῶν βασιλέων τῶν Αἰγυπτίων. ἐκείνοις γὰρ φασὶ κομισθῆναι ποτ' ἐν δώροις παρὰ τοῦ Βαβυλωνίων βασιλέως μῆκος μὲν τετράπηχυν πλάτος δὲ τρίπηχυν ἀνακεῖσθαι δὲ καὶ ἐν τῷ τοῦ Διὸς ὀβελίσκῳ σμαράγδους τέτταρας, μῆκος μὲν τετταράκοντα πηχῶν, εὖρος δὲ τῇ μὲν τέτταρας τῇ δὲ δύο. ταῦτα μὲν οὖν ὅτι κατὰ τὴν ἐκείνων γραφὴν. τῶν δὲ βακτριανῶν καλουμένων ὑπὸ πολλῶν ἢ ἐν Τύρῳ μεγίστη· στήλη γὰρ ἔστιν εὐμεγέθης ἐν τῷ τοῦ Ἡρακλέους ἱερῷ· εἰ μὴ ἄρα ψευδὴς σμάραγδος, καὶ γὰρ τοιαύτη γίνεται τις φύσις.

⁴⁵ *N. H.* 37, 75: Apion cognominatus Plistonices paulo ante scriptum reliquit esse etiam nunc in labyrintho Aegypti colossus Serapis e smaragdo novem cubitorum.

⁴⁶ See above, p. 181, n. 11.

⁴⁷ Rawlinson, *op. cit.* 2, 71; Deville, *op. cit.* 5; Nesbitt, *op. cit.* 11; Gerspach, *op. cit.* 8; Garnier, *op. cit.* 21. How and Wells, *op. cit.* 1, 188, disagree, indeed, but without good reason.

⁴⁸ *Recogn.* 7, 12: post haec dicta unus ex astantibus Petrum rogare coepit, ut die crastina maturius ad insulam proximam quae sex non amplius stadiis aberat, Aradum nomine, pergeremus, videndi in ea gratia mirum aliquod opus, columnas vitreas magnitudinis immensae. cui Petrus, ut erat clementissimus, acquiescit, sed monuit nos, cum navem descendissemus, non una omnes concurrere ad videndum. 7, 13: Petrus vero ubi solas columnas miratus est vitreas. 7, 26: haec cum mihi Clemens enarrasset, accessit ad nos quidam rogans, ut ad insulam Aradum quae vicina erat recederemus, videndi gratia columnas vitreas mirae magnitudinis.

B. IMITATION OF PRECIOUS AND SEMIPRECIOUS STONES

I. *Kinds*

a. *Emerald*. Since glass was so easily confused with other transparent substances in early times, it is natural that the possibility of using it to imitate precious stones should soon suggest itself. We have just noted the employment of imitation emeralds, probably green glass, in making tables, columns, statues, and obelisks.¹ Petronius (*S.* 1)^{1a} virtually calls the emerald glass in a certain passage. Nero (*S.* 1) used an emerald or green glass to shade and rest his eyes.^{1b} It would be interesting at this point if only Pliny (*S.* 1)² had preserved for us some of the numerous recipes for imitating emeralds, which he claims to have had before him. Irenaeus (*S.* 2/3)³ and after him Isidore (*S.* 6/7)⁴ record that the glass imitations of the costly emerald were made so skilfully that it was difficult to recognize them for what they were. The alchemist supplies the recipes which were omitted by the more technical writers.⁵

b. *Lapis Lazuli*. The natural *kyanos* of Theophrastus (*S.* IV/III) has been identified with lapis lazuli, and the artificial with a blue glass-paste.⁶

c. *Crystal*. The perfection of glass until it not only resembled crystal, but was even called crystal, has been discussed above.⁷

d. *Murra*. Although we do not know what the natural *murra* was, or even whether it existed, Pliny seemed to think that it came from the ground, and he tells us that it was imitated in glass. It was mentioned elsewhere as a manufactured product.⁸

e. *Opal*. Pliny⁹ says that opals are among the easiest stones to

¹ See above, p. 142ff.

^{1a} See below, n. 43.

^{1b} See below, p. 150, n. 43.

² See above, p. 181, n. 10-11.

³ *Contra Haer.* 1, 2 (*Patr. Gr.* 5, 1388 A): ὅτι λίθον τὸν τίμιον σμάραγδον ὄντα καὶ πολυτίμητόν τισιν ὕαλος ἐνυβρίζει διὰ τέχνης παρομοιουμένη, ὅπταν μὴ παρῇ ὁ σθένων δοκιμάσαι καὶ τέχνη διελέγξει τὴν πανούργως γενομένην.

⁴ *Orig.* 16, 15, 27: nam et pro lapide pretiosissimo smaragdo quidem vitrum arte inficiunt, et fallit oculos subdole quadam falsa viriditas; quoadusque non est qui probet simulatum et arguat. See above, p. 109, n. 15.

⁵ Berthelot, *Collection*, 346; 349, 1; 350 ff.; 353; 361, 35.

⁶ See above, p. 14.

⁷ See above, p. 53ff., 79ff.

⁸ See above, p. 83ff.

⁹ *N. H.* 37, 83: vitia opalis sunt, si color in florem herbae, quae vocatur heliotropium, exeat aut in crystallum aut grandinem . . . nullos magis fraus indiscreta

imitate, but that it is possible to distinguish the true from the false by holding them to the light.

f. *Carbunculus*. The *carbunculus* was a red stone, probably the ruby or garnet. Pliny tells how to identify the glass imitations; they are softer, brittle, lighter in weight, and sometimes contain bubbles.¹⁰

g. *Topaz*. The topaz of Pliny was a chrysolite or green jasper. He says that no gem was more easily imitated in glass.¹¹

h. *Jasper*. According to Pliny the way to distinguish a jasper from a glass gem is by the type of reflection.¹²

i. *Hyacinthus*. Closely resembling the amethyst was a stone called *hyacinthus*¹³ from the color of the hyacinth flower. There were some hyacinths that resembled glass, and were, therefore, easily imitated. In fact they could not be distinguished by sight, but the glass was warmer to the touch.

j. *Obsidian*. Pliny¹⁴ very naturally classes the black, glassy, volcanic rock, obsidian, as a type of glass. "Among the various kinds of glass, we may also reckon Obsian glass, a substance very

similitudine vitro adulterat. experimentum in sole tantum: falsis enim contra radios libratis digito ac pollice unus atque idem tralucet colos in se consumptus; veri fulgor subinde variatur et modo ex hoc plus, modo ex illo spargit, fulgorque lucis in digitos funditur.

¹⁰ *Id.* 37, 98: adulterantur vitro simillime, sed cote deprehenduntur, sicut aliae gemmae; fictis enim mollior materia fragilisque est. centrosas cote deprehendunt et pondere, quod minus est in vitreis, aliquando et pusulis argenti modo relucetibus. Berthelot, *Collection*, 350 ff.

¹¹ *Id.* 37, 112: neque est imitabilior alia mendacio vitri.

¹² *Id.* 37, 117: et vitro adulterantur, quod manifestum fit, cum extra fulgorem spargunt atque non in se continent.

¹³ *Id.* 37, 128: sunt et in hoc genere capniae. sunt et vitreis similes, velut croco fulgentes; vitro adulterantur, ut visu discerni non possint; tactus deprendit, tepidior in vitreis. See also above, p. 109, n. 15. Berthelot, *Collection*, 350 ff. *Lib. Sac.* 189 (Berthelot, *Hist.* 1, 223): ad faciendum jacintos.

¹⁴ *N.H.* 36, 196ff.: in genere vitri et obsiana numerantur ad similitudinem lapidis, quem in Aethiopia invenit Obsius, nigerrimi coloris, aliquando et tralucidi, crassiore visu atque in speculis parietum pro imagine umbras reddente. gemmas multi ex eo faciunt; vidimus et solidas imagines divi Augusti capaci materia huius crassitudinis, dicavitque ipse pro miraculo in templo Concordiae obsianos IIII elephantos. remisit et Tiberius Caesar Heliopolitarum caerimoniis repertam in hereditate *Sei* eius, qui praefuerat Aegypto, obsianam imaginem Menelai, ex qua apparet antiquior materiae origo, nunc vitri similitudine interpolata. Xenocrates obsianum lapidem in India et in Samnio Italiae et ad oceanum in Hispania tradit nasci. fit et tincturae genere obsianum ad escaria vasa et totum rubens vitrum atque non tralucens, haematinum appellatum. Translation by Bostock and Riley. Cf. *Isid. Orig.* 16, 5. See Bone (*Mitteil. des Arch. Inst.* 23 (1908), 145ff.).

similar to the stone which Obsius discovered in Aethiopia. This stone is of a very dark color, and sometimes transparent; but it is dull to the sight, and reflects, when attached as a mirror to walls, the shadow of the object rather than the image. Many persons use it for jewelery, and I myself have seen solid statues in this material of the late Emperor Augustus, of very considerable thickness. That prince consecrated, in the Temple of Concord, as something marvellous, four figures of elephants made of Obsian stone. Tiberius Caesar, too, restored to the people of Heliopolis, as an object of ceremonial worship, an image in this stone, which had been found among the property left by one of the praefects of Egypt. It was a figure of Menelaus; a circumstance which goes far towards proving that the use of this material is of more ancient date than is generally supposed, confounded as it is at the present day with glass, by reason of its resemblance. Xenocrates says that Obsian stone is found in India also, and in Samnium in Italy, and that it is a natural product of Spain, upon the coasts which border the Ocean. There is an artificial Obsian stone, made of colored glass for services for the table; and there is also a glass that is red all through, and opaque, known as 'haematinum' (blood-red)." One cannot but wonder whether the statues mentioned by Pliny were natural or artificial.

k. *Sapphire*. After listing a number of colors and stones, including the sapphire, which are imitated in glass, Pliny¹⁶ adds that there is no material which lends itself so well to working and coloring.

l. *Pearls*. Although some do not believe that false pearls were known at an early date,¹⁷ there seems to be sufficient evidence, both literary^{17a} and archaeological,¹⁸ that they were. Fenestella said that after the capture of Alexandria pearls came into common and general use at Rome.¹⁹ To be sure there is no indication that these or any of the numerous pearls mentioned by Pliny²⁰ were of glass,

¹⁶ See above, p. 83, n. 1; p. 109, n. 15.

¹⁷ Wallace-Dunlop, *op. cit.* 155.

^{17a} Berthelot, *Collection*, 364, 368.

¹⁸ Duhn, *Mittheil. des. k. d. Arch. Inst. Röm. Abtheil.* 2 (1887), 254; Orsi, *id.* 24 (1909), 97; Perrot et Chipiez, *op. cit.* 6, 943; *Jahrb. des Arch. Inst.* 3 (1888), 245; 15 (1900), 3; 19 (1904), 48; 25 (1910), 211; 26 (1911), 314; Schneider, *Jahresheft des österreich. arch. Inst.* 2, (1899), 203; Weisshäupl, *ibid.* 3 (1900), *Beibl.* 198; Blümner (*P.-W.* 7, 1382); *Jahrb. des Arch. Inst.* 29 (1914), 291.

¹⁹ Plin. *N. H.* 9, 123: Romae in promiscuum ac frequentem usum venisse Alexandria in dicionem redacta.

²⁰ 9, 106f.

but since Alexandria was the center of the manufacture of the finer glass products, no less than the principal port for Oriental trade, and since glass pearls certainly were made in considerable numbers during the empire, one may be allowed a shrewd suspicion that some, at least, of the numerous pearls which came to Rome from Alexandria may have been paste. The imitation, however, cannot have been regarded as very satisfactory, because the discrepancy in value gave rise to a proverb: "Is a glass pearl worth as much as a genuine one?"²¹

m. *Onyx*. The imitation of onyx is mentioned by Isidore (*S.* 6/7).²²

The few stones recorded above by no means conclude the list. Pliny, and after him Isidore and Rabanus Maurus, says that other gems were imitated, and this we know from the museum collections, but the aim has been to mention only those which occur in literature.²³

2. Uses

a. *Adornment of Objects*. The first use of glass was probably as a glaze for necklaces and other jewelery for personal adornment.^{23a} Later, glass was applied to larger objects either as a surface glaze or paste or in the form of gem-like adornments. In Homer *kyanos* was used in small quantities in the decoration of armor.²⁴ Of course this may have been only a coloring material, but it is mentioned along with such other substances as gold and silver; so there seems to be no reason why it is not the same as the glass paste used in the frieze. Leo the Grammarian (*S.* 9)²⁵ speaks of Theophilus adorning two

²¹ Tert. *Ad. Mart.* 4: tanti vitreum, quanti verum margaritum? Hier. *Epist.* 29, 7, 8: si tanti vilissimum vitrum quanti pretiosissimum margaritum. 130, 6, 6: tanti, ut dicitur, vitrum, quanti margaritum. Valer. *Homil.* 15, 2, brings out the similarity between glass and pearls (since he is obviously referring to the 'Pearl of Great Price'), but also the great difference in value: in comparatione autem paradisi, vitro similis est gemma pretiosior.

²² See above, p. 109, n. 15.

²³ Nöggerath, *Die Kunst Gemmen zu Färben* (*Jahrb. des Vereins v. Altertumsfreunden*, 10 (1847), 84); Blummer, *Tech. u. Term.* 4, 391; Berthelot, *Hist.* 1, 180; 2, IX, XV, XXI, XXXIII, XXXVIII, XLVII, 29, 173, 194, 195, 229, 284, 287, 330; *Origines*, 71, 93, 101, 125, 199, 232, 240, 242, 244, 346; *Introduction*, 202, 271.

^{23a} See above, n. 83, 1; below, n. 35.

²⁴ See above, p. 11.

²⁵ *Chronograph.* (*Patr. Gr.* 108, 1048): τὰ δύο μέγιστα ὄργανα ὁλόχρυσα διαφόροις λίθοις καὶ ὑελίοις καλλύνας αὐτά. Cf. Georgius Monachus, *Chron.* 4 (*Patr. Gr.* 110, 1009).

very large instruments of solid gold with a variety of precious stones and glass gems.

b. *Earrings*. Glass gems no doubt passed through two periods. At first the novelty of glass to the Greeks caused it to be classed with things that were rare and valuable. Then as glass became common and cheap, say at the beginning of the Roman empire, gems were made of it to deceive wealthy buyers, as well as to supply the poorer people who could not afford real jewels.

In Herodotus' day (*S. V*) glass gems were still in the first stage. In fact glass was called a stone, not one which was dug up, but a 'molten stone.' The Egyptians deemed glass worthy to adorn their sacred crocodiles; "they put earrings of glass and gold in their ears and anklets about their feet."²⁶ Petronius (*S. I*)²⁷ has Habinnas call his wife's earring a glass bean. In a partially unintelligible passage Hesychius (*S. 5*)²⁸ speaks of glass earrings set in gold.

c. *Rings*. In an inventory of the temple of Athena²⁹ taken in the fourth century before Christ, and in an inventory of the temple of Apollo at Delos taken the next century under Hypsocles,^{29a} a number of glass rings are mentioned. Possibly these were signet rings, for glass gems containing inscriptions of various types have been found widely distributed.³⁰ In explaining the color *anulare* Pliny³¹ says that "it is prepared from chalk mixed with glass jewels from the rings (*anuli*) of the common people, and for this reason it was called *anulare*." It is clear, therefore, that cheap rings were usually fitted with glass sets. Theophilus has a whole chapter on the making of glass rings.³²

²⁶ See above, p. 20, n. 2.

²⁷ 67, 10: 'quid?' inquit Habinnas 'excataressasti me, ut tibi emerem fabam vitream.'

²⁸ *S. v. ἄρκαλ[λ]α*: λευκά καὶ ἐνώτια ἐξ ὕαλου περίχρυσα· οἱ δὲ ξύλα ξηρά. For such decoration see Hadaczek, *Der Ohrschmuck der Gr. u. Etr. (Abhandl. des archäol.-epigraph. Sem. d. Uni. Wien. 14* (1903), 9, 34, 45, 48ff.).

²⁹ IG 2, 652, 28: σφραγίς ὑάλινη. 35: σφραγίδε ὑάλινα ποικίλα 11. 38: σφραγίς ὑάλινη [περικεχρυσ] | ωμένη. 40: σφραγίδες ὑάλιναι: Γ 11: ποικίλαι περικε[χρυσωμένα. 2, 683, 13: σφραγίς ὑάλινη. In 4, 672C, Köhler supplies line 12: δακτύλοι σιδηροὶ Γ 111, πρὸς ἐνὶ χρυσίον ἄπυρον πρόσεστι, σφραγίς ὑάλινη.

^{29a} IG 11, 2, 161, 50: σφραγίδιον ὑάλινον χρυσένδετον. Homolle, *Comptes des Hiéropes du Temple D'Apollon Délien* (Bull. de Corresp. Hellén. 6 (1882), 122).

³⁰ CIL 1, 1, 2405; 12, 5693, 11; 13, 3, 2, 75, 128b, 134, 139, 145, 146, 149, 153, 225, 302, 385, 410, 452b, 463, 464, 668.

³¹ *N. H.* 35, 48: *anulare* quod vocant, candidum est, quo muliebres picturae inluminantur; fit et ipsum e creta admixtis vitreis gemmis e volgi anulis, inde et *anulare* dictum.

³² 2, 31.

d. *Trifles of Export.* It has always been true that less civilized peoples prize trifles of adornment more than objects of practical value. Doubtless a glass bead was valued as much by an African of the fourth century before Christ as by an American Indian of more recent times. At least in bartering with them "the Phoenician merchants imported to them perfume, Egyptian stone," etc.³³ The author of the *Periplus of the Red Sea*³⁴ records that the Egyptians of the first century after Christ exported to the Berbers many kinds of glass stones and murrine made at Diospolis. *Hyala skeuê*,^{34a} 'glass wares,' were also among the articles of export. Usually this expression means utensils of glass, but here, as well as in the list of exports from Gaul to Britain mentioned by Strabo,^{34b} we are probably to think of glass beads³⁵ and trifles of glass which would be prized by less advanced peoples. Probably the *vitrea* which the Aethiopians imported^{35a} should be included here rather than taken as glass vessels.

e. *Cups.* Under murrine and crystalline cups probably glass is often meant.³⁶ When mention is made of drinking from gems or gemmed cups,³⁷ one imagines that they were really glass gems.

f. *Bullae.* Calpurnius (*S.* 1)³⁸ speaks of *vitreae bullae*, 'glass

³³ See above, p. 21, n. 8.

³⁴ See above, p. 21, n. 10-11. Kisa, *op. cit.* 164: "Gläserne Steine verschiedener Forme." *Peripl.* 49, 56: ὑαλὸς ἀργή. Salmasius, *Plin. Exercit.* 252 a D: ἀργὸς ὑάλην apud Arrianum in periplus iners et rude vitrum, et quod in masa est: λιθίαν ὑάλην alibi vocat."

^{34a} *Id.* 39: ὑαλᾶ σκεύη.

^{34b} See above, p. 132, n. 48. Dillon, *op. cit.* 85: "We must interpret as beads of glass and amber."

³⁵ On glass beads: Schliemann, *Mycenae* (1878), 158; *Tiryns* (1885), 82ff.; Schuchhardt, *Schliemann's Excavations* (1891), 124, 258; Dawkins (*The Annual of the Brit. School at Athens*, 10 (1904), 215; 11 (1905), 291); Gardner-Casson (*id.* 23 (1918), 22); Eisen (*A. J. A.*, Ser. 2, 20 (1916), 134ff.). Evans, *The Palace of Minos* (1921), 486ff.; Xanthoudides, *The Vaulted Tombs of Mesará*, trans. by Droop (1924), 124.

^{35a} Plin. *N. H.* 12, 88: hi recto cursu per sinus inpellunt atque a promunturii ambitu argeste deferunt in portum Gebbanitarum qui vocatur Ocilia. quamobrem illi maxime id petunt, produntque vix quinto anno reverti negotiatores et multos interire. contra revelunt vitrea et aenea, vestes, fibulas cum armillis ac monilibus. ergo negotiatio illa feminarum maxime fide constat.

³⁶ See above, p. 79ff.; 83ff.

³⁷ Mart. 10, 49, 1: cum potes amethystinos tries. 11, 11: te potare decet gemma. 14, 94, 1: nostra neque ardenti gemma feritur aqua. See below, p. 164, n. 94; p. 165, n. 110. Friedlander (1886): "Gemma=glass." See above, p. 109, n. 17.

³⁸ *Ecl.* 41 (39): aspicias, ut niveo frons irretita capistro | lucet, et a dorso, quae totam circuit alvum, | alternat vitreas lateralis cingula bullas?

amulets.³⁹ Since, however, *bullae* were usually of gold, the word *vitreae* might conceivably mean simply 'glistening,' although that would appear most improbable.

g. *General Terms.* When the Book of Job was written (*S.* VI/II),⁴⁰ glass or paste jewels were still extremely valuable. Varro (*S.* I)⁴¹ mentions *vitrum* along with pearls and emeralds. Diodoros (*S.* I)^{41a} writes of a little crystal which was sent as a gift. This may have been of real crystal or possibly of glass. The same might be said of crystal mentioned in the list of precious gifts sent by devoted lovers; "one will send crystal, another silver, and others topazes."⁴² Petronius (*S.* I)⁴³ in a similar connection asks, "Why do you desire the green emerald, precious glass?" Clement of Alexandria (*S.* 2/3)⁴⁴ inveighs against the folly of being attracted by transparent stones and colored glass. Trebellius Pollio (*S.* 4)⁴⁵ tells an anecdote about the punishment given by the emperor Gallienus to a man who had deceived the empress. When the emperor discovered that the merchant had sold his wife glass gems for genuine ones, he pretended that he was going to throw him to the lions. However, on the appointed day when the crowd was anxiously waiting to see the execution, the cage opened, and, instead of a lion a capon stepped out. The emperor, considering that the fraudulent dealer had suffered sufficiently, dismissed the case.

C. GLASS VESSELS

To the Greeks of the classical age glass was something rather foreign; to the Romans of the first century before Christ something

³⁹ Keene (1887): "Glass amulets." Scott (1890): "Glass beads," which can scarcely be right. On glass amulets: Petrie, *Naukratis*, I (1886), 43, 53; Blümner (*P.-W.* 7, 1382).

⁴⁰ See above, p. 134, n. 3.

⁴¹ *Menipp. Frag.* 591 (Bücheler, *Petr.*, ed. 5, 224), *Papiapapae*, 13 (8), 382: *imperito nunnumquam concha videtur margarita, vitrum smaragdus.*

^{41a} See above, p. 54, n. 9.

⁴² See above, p. 54, n. 10.

⁴³ *Satur.* 55, 6, 10: *zmaragdum ad quam rem viridem, pretiosum vitrum?*

⁴⁴ *Paedag.* 2, 12, 118 (*Patr. Gr.* 8, 540): *ἐπὶ γὰρ τὰ διανγῇ τῶν λιθιδίων καὶ τὰς ἰδιαζούσας χροῶς ὑέλους [ὑέλους N] τε ἰεσθαι ποικίλας οὐδὲν ἀλλ' ἢ ἀνοήτων ἐστὶν ἀνθρώπων ὑπὸ τῶν πληκτικῇ ἐχόντων φαντασίαν ἐλκομένων.*

⁴⁵ *Gall. Duo.* 12, 5: *idem, cum quidam gemmas vitreas pro veris vendidisset eius uxori, atque illa re prodita vindicari vellet, subripi quasi ad leonem venditorem iussit, deinde e cavea caponem emitti, mirantibusque cunctis rem tam ridiculam per curionem dici iussit: 'inposturam fecit et passus est.' deinde negotiatorem dimisit.*

new; and to both something extremely useful and ornamental. There are many points which we should like to know, such as how, when, and where the first vessels were fashioned, and when the first glass was blown. Literature does not answer these questions, but literature, as well as archaeology, testifies to the popularity of glass for vessels. Seneca (*S.* 1)¹ says, "I should like to show Posidonius some glass-blower who by his breath fashions glass into numerous shapes, which could scarcely be accomplished by the most skilful hand." Athenaeus (*S.* 2/3)² too mentions the numerous shapes when he writes, "The men of Alexandria, they say, fashion the glass they make into many different kinds of cups, imitating the form of all earthen vessels imported from every quarter." In *De Providentia* Theodoret (*S.* 5) marvels at the source of knowledge of him who makes and fashions glass. He asks, "How does he know to form from this mass, by the use of fire and breath, countless forms of cups, flat vessels, calices, narrow necked vessels, little amphorae, utensils, and other vessels suitable for every use of meat and drink?"³ It seems best to list the designations for these different glass vessels in their chronological order.^{3a}

1. *Ekpoma* (Goblet). The first reference to a glass vessel occurs in Aristophanes' *Acharnians* (*S.* V)⁴ where ambassadors at the Persian court drank from *ekpomata*, 'goblets,' of glass and gold. This passage has been frequently quoted, often as an example of the preferred spelling of the word for glass.⁵ There is no indication in any of the other places where glass *ekpomata* are mentioned⁶ that

¹ See above, p. 107, n. 41.

² See above, p. 130, n. 20.

³ 4, 39 (*Patr. Gr.* 83, 617 A f.): πόθεν ἔμαθε φύσιν ὑέλου; τίς αὐτὸν τῆς ψάμμου τὴν διαφορὰν ἐπαίδευσε; τίς αὐτὸν ἐδίδαξε τὴν τοιάνδε ψάμμου τῷ πυρὶ παραδίδοσθαι, καὶ ὅπως, καὶ ἐπὶ πόσον; καὶ τὴν συνεχῇ μὲν χωρίζειν, τὴν χωριστὴν δὲ εἰς συνεχὲς ἀχώριστον μεταβάλλειν; πῶς ἔγνω διαπλάττειν ἐκ ταύτης, πυρὶ καὶ πνεύματι συνεργῶ κεκρημένος, ἐκπωμάτων εἶδη μυρία, φιάλας, καὶ κύλικας, καὶ βομβύλους, καὶ ἀμφορίσκους, καὶ ἐπιπλα, καὶ ἕτερα σκεύη πρὸς πᾶσαν χρεῖαν βρωτῶν καὶ ποτῶν ἐπιτήδεια.

^{3a} From number 62 on the names of the vessels come from Berthelot, *Collection*, and are not in strictly chronological order.

⁴ See above, p. 134, n. 4.

⁵ See above, p. 36, n. 17.

⁶ See above, p. 55, n. 13. Lucian, *Quomodo Hist.* 25: τυχεῖν μὲν γὰρ αὐτὸν ἔχοντα παμμεγέθη ἐκπώματα ὑάλινα τῆς καλίστης ὑάλου. ἐπεὶ δὲ πάντως ἀποθανεῖν ἔγνωστο, κατὰξαντα τὸν μέγιστον τῶν σκύφων ἐνὶ τῶν θραυσμάτων χρῆσασθαι εἰς τὴν σφαγὴν ἐντεμόντα τῇ ὑάλῳ τὸν λαιμόν. Philostrate. *Epist.* 33 (24): ἐξ ὑέλου μὲν τὰ ἐκπώματα, αἱ δὲ σαῖ χεῖρες ἀργυρᾷ αὐτὰ ποιοῦσι καὶ χρυσᾷ, ὥς τοῦτοις τὸ

they were used for anything but drinking vessels. It is interesting to note the change in value from the glass which was ranked with gold in the time of Aristophanes to the cheaper product of a later date.

2. *Angeion* (*Vessel*). *Angeion*, 'vessel,' is used very frequently by physicians to designate a receptacle for holding medicine or its components, or something to be observed and tested,⁷ in other words, something like our 'test-tube.' Alexander Aphrodisiensis (*S.* 2/3)⁸ argues that water behaves the same in glass as in earthenware vessels. Pollux (*S.* 2/3)⁹ mentions a glass wine jar. Pseudo-

βλέπειν ὑγρῶς παρὰ τῶν σῶν ὁμμάτων εἶναι. See above, n. 3. Joan. Act. *de Urinis*, 2, 33, 7: αἶ δὴ κατὰ τὸ σχῆμα τοῖς υἑλίνοις τούτοις ἐκπώμασιν ἐοίκασιν, οἷς δῆτα χρώμεθα οἱ πίνοντες. In Philostrat. *Epist.* 32, the "transparent goblets" were probably of glass.

⁷ Hippocrates, *Epist.* 16, 6: πάντα δὲ ὁκόσα χυλοὶ καὶ ὅποι ῥέοντες ἐν υἑλίνουσιν φερέσθωσαν. Damocrat. in Galen, 13, 41: ψύξας δ' ἀποθήσεις εἰς υἑλοὺν ἀγγεῖον. 13, 1056: εἰς πυξίδ' ἀπόθου ἢ εἰς υἑλοὺν ἀγγεῖον. 14, 99: μὴ ξυλίνους ἀγγεῖους, υἑλίνους δὲ μᾶλλον. 14, 130: ἐκ τῆς θυίδος εἰς υἑλοὺν ἀγγεῖον. Diosc. 5, 110: φυλάττεται δὲ ἐν υἑλίνοις, ἢ μολυβδίνοις, ἢ κασσιτερίνοις, ἢ ἀργυροῖς ἀγγεῖοις. Moschion. *de Mulier. Passion.* 116: εἰς ἀγγεῖον υἑλινον. Galen, 12, 490: εἰς ἀγγεῖον υἑλινον εὔτονον. 12, 631: ὁμοῦ ἐν υἑλίνῳ ἀγγεῖῳ ἐπὶ θερμοσποδίας θέρμαινε. 12, 637, 660, 827; 13, 56; 14, 403: εἰς ἀγγεῖον υἑλινον. 13, 54, 98: εἰς ἀγγεῖον υἑλοὺν. 13, 746; 14, 392, 406, 539: ἐν υἑλίνῳ ἀγγεῖῳ. 13, 1045: ἐν υἑλίνοις ἀγγεῖοις. 14, 48: ἢ δ' ἀπόθεις ἐν ἀγγεῖῳ καττιτερινῷ ἢ υἑλίνῳ ἢ χρυσῷ γινέσθω. τὸ μὲν οὖν υἑλινον καὶ τὸ χρυσὸν οὐδεμίαν ἔχει τὴν δόλωσιν, ὃ δὲ καττιτερινὸς μίξει μολύβδου δολοῦται. 14, 409: ἐν υἑλῳ ἀγγεῖῳ. Ael. Promotus (Wellmann, *Corp. Med. Gr.* 10, 1, 1 (1908), 9, 9): φύλαττε δὲ τοῦ πάσχοντος τὸ οὖρον ἐν υἑλίνῳ ἀγγεῖῳ. Philumenus, *de Venenatis Animalibus*, 4, 15: φύλασσε δὲ τοῦ κάμνοντος <τὸ> οὖρον ἐν υἑλίνῳ ἀγγεῖῳ. Note on υἑλίνῳ: "ὑδατι P: corr. by Wellman from Aelius Promotus." Orib. *Collect. Med.* 5, 21 (Bussemaker-Daremborg, 1 (1851), 384, 9): θλίψαντά τε μετὰ τὴν ἀπόθειν εἰς ἀγγεῖον υἑλοὺν δέχεσθαι τὸ ὑγρὸν, μίξαντά τε καλοῦ μέλιτος ἀπηφρισμένου μέρος ἐν πρὸς τρία μέρη. 4, 630, 4: ὃ δὲ χυλὸς ἔψεται ἕως μέλιτος σχῆ ἰσχύος, καὶ ἀποτίθεται ἐν υἑλῳ ἀγγεῖῳ. *Synop.* 5, 3 (Bussemaker-Daremborg, 5 (1873), 199, 11): ἐγχεάντα τὸ ὀγδοημόριον τοῦ γάλακτος εἰς ἀγγεῖον υἑλινον. Paul. Aeg. 1, 3—δοκιμάζειν δὲ καὶ οὕτως ἐγχεόντα τοῦ γάλακτος εἰς ἀγγεῖον υἑλινον ἐμβαλλεῖν ταμίσου τὸ σύμμετρον καὶ διαθλίψαι τοῖς δακτύλοις. 3, 1, 6: ἐν ἀλείῳ υἑλῳ. 3, 2, 6: εἰτα ἐμβαλε ἐν ἀγγεῖῳ υἑλίνῳ . . . πάντα βάλων εἰς ἀγγεῖον υἑλοὺν. 7, 8, 6: καὶ ἀναβάλλοντα μέλιτι καλλίστῳ ἀποτίθεται εἰς υἑλοὺν ἢ μολιβδὸν ἀγγεῖον. 7, 20, 11: ἀποτιθεμένου ἐν ἀγγεῖοις υἑλοῖς. 35, 1, 10 (ed. Ald.): καὶ ἐνώσας ἀπόθου ἐν υἑλῳ ἀγγεῖῳ. 127, 7: καὶ πλάσσοντα ἀποτίθεται ἐν ἀγγεῖοις μάλιστα χαλκοῖς, ἢ υἑλοῖς. *Chirurg.* 368, 90: πλανώνται δὲ οὗτοι· οὐδὲ γὰρ ὥσπερ ἐπὶ τινῶν υἑλίνων ἀγγεῖων. *Hippiatr.* 1, 30, 103: καὶ κένον ἐν ἀγγεῖῳ υἑλίνῳ. Demetrius, *Hier.* 205: θηράσας νυκτερίδας ἐσφάζον αὐτάς καὶ τὸ αἷμα αὐτῶν ὑπόδεξι ἐν ἀγγεῖῳ υἑλίνῳ.

⁸ *Problem.* (Ideler, *Phys. et Med. Gr. Min.* 1 (1841), 41, 15): ὅτι δὲ πόρους ἔχει ἡ ὑἑλος, ὅπλοῖ καὶ τὰ ὀσπράκινα τῶν ἀγγεῖων. ἐν γὰρ τῷ θέρει τὸ ἐμβαλλόμενον ὑδρὶ ἐξιδροῖ ἐὰν μὴ πισσωθῇ. ἔστι δὲ καὶ καπνὸν ἰδεῖν ἐξιόντα διὰ τοῦ σώματος τῆς ὑἑλου κατὰ τὸν χειμῶνα.

⁹ 6, 14: ἀγγεῖον οἰνοφόρον υἑλου ἢ κεράμου πεποιημένον. Note: "υἑλόν C. V., υἑλοὺν ἢ κεραμοῦν C. A."

Callisthenes (*S.* 3)¹⁰ tells of a poison so virulent that a glass vessel will not hold it. Titus Bostrensis (*S.* 4)¹¹ describes a glass vessel full of water which was used as a burning glass. A gloss defines *fidelia* as a glass vessel.¹² Philoponus (*S.* 6)¹³ mentions a glass vessel when discussing transparency. The *Geoponica* (*S.* 10) speak of a glass vessel as being good for keeping oil¹⁴ and mulberries,¹⁵ also of the possibility of seeing when things settle, if they are contained in a glass vessel.¹⁶ A scholiast on Aristophanes mentions glass *angeia* as the principal stock of the lekythos sellers.¹⁷ The form *angion* occurs in a Greek alchemical papyrus.^{17a} Like the physician, the alchemist frequently made use of the *angeion*^{17b} In the quotation given below, it is called an *ambix*, *bikion*, and *troullion*; it is described as *stenostomon*, *arsenothelu*, *anaklastarion*, and *diaplasion*.

3. *A 'Glass' (Hyalos, Hyalion, etc., Vitrum, Vitreum, etc.).* The most common way to designate a glass vessel is by the use of the noun meaning 'glass,' or of the neuter of the adjective meaning 'of glass.' 'A glass' at once suggests a drinking vessel, but there are instances where it is impossible to be sure of the nature or use of

¹⁰ 3, 31: οὐκ ἔφερον ἀγγεῖον οὔτε ὑάλινον.

¹¹ See below, p. 179, n. 9.

¹² *Corp. Gloss. Lat. s. v. fidelia.* ἀγγεῖον ὑελούν.

¹³ In *Meteor. A* 3 (Arist. 341a35), 49: διὰ τὴν αὐτὴν δὲ αἰτίαν καὶ ὕδατος τὸ ὑέλιον ἀγγεῖον πληροῦται, ἵνα τῆς ὑέλου τοὺς πόρους ἀποφράξῃ.

¹⁴ 9, 19, 9: καὶ ἐμβάλλειν εἰς ἀγγεῖον ὑελούν.

¹⁵ 10, 70: συκάμινα ἐν ὑελίνῳ ἀγγεῖῳ ἐμβληθέντα ἐπιμελῶς ἐπὶ πλείστον διαμένει χρόνον.

¹⁶ 5, 7, 2: βόθρον ὀρύξας ἐν τῷ μελλούσῃ φυτεύεσθαι γῇ ἐπὶ δύο πόδας, λαβὼν βῶλον ἐκ τῆς ἀνορυγείσης γῆς βάλε εἰς ἀγγεῖον ὑελούν μετὰ ὀμβρίου ὕδατος καθαροῦ, καὶ μίξας καὶ θολώσας τὸ ὕδωρ, ἔασον καταστῆναι τελείως, τότε δὲ διὰ τῆς τοῦ ὑέλου διαφανείας γενήσεται σοι φανερόν, καὶ ἐπειδὴν εἰς τέλος καταστῇ, γεῦσαι τοῦ ὕδατος.

¹⁷ *Ad Plut.* 427: λεκυθόπωλις λέγεται ἡ τὰ ὑέλινα ἀγγεῖα κυρίως πωλοῦσα.

^{17a} Wessely, *Par. Mag. Paris (Denkschr. d. Wien. Akad.* 36 (1888), 758): βαλε εἰς ἀγγιον ὑελουν (*sic*).

^{17b} Olympiodorus, 12 (Berthelot, *Collection*, 75): εἰς ὑελούν ἀγγεῖον στενός-τομον ἄνωθεν κατησφαλισμένος. Zosimus, 1 (*Collection*, 141): λαβὼν δὲ ἀγγεῖον ὑελούν ἀρσενόθηλον τὸν καλούμενον ἄμβικα . . . βάλλε ἐν τῷ βικίῳ. Ostanès, 2 (*Collection*, 261ff): ἔκχεον ἐν ὑελίνῳ ἀγγεῖῳ . . . ἐπίβαλλε ἐν ὑελίνῳ ἀγγεῖῳ. Moses, 59 (*Collection*, 313): ἔγκλειε ἐν ὑελίνῳ ἀγγεῖῳ. Berthelot, *Collection*, 350, 1: βάλε εἰς ἀνακλαστήριον ἀγγεῖον ὑάλινον. 359, 24: ἐμβαλον ἐν ὑάλινῳ ἀγγεῖῳ. 384, 2: ἐν ἀγγεῖῳ ὑελίνῳ. 420, 11: χαλᾶς ἐν ἀγγέσις ὑελοῖς. 422, note 6: ἐν ὑάλινῳ ἀγγεῖῳ διαπλασίῳ. Niceph. Blemm. 11 (*Collection*, 455): καὶ δέχον τὸ σταχθὲν ἅπαν ἐν ἀγγεῖῳ ὑελίνῳ. Leemans, *Papyri Gr. Musei Antiquarii Publici Lugduni Batavi*, 2 (1885), 10, 16, 27: ἐν ὑελοῖς ἀγγέλιος.

the vessel,¹⁸ just as the plural 'glasses' is the common expression now for spectacle lenses.

Naturally it did frequently indicate a cup for drinking wine or water. Petronius (*S.* 1) has Trimalchio say, "You'll excuse me for what I'm about to say: I prefer glass vessels; at least, they don't smell, and if they weren't so fragile, I'd prefer them to gold; however, they are cheap at present."¹⁹ Again in speaking of flexible glass, Tiberius Caesar asked the maker if anyone else knew this method of preparing glasses.²⁰ Martial (*S.* 1)²¹ twice speaks of drinking from a glass, and in the second instance he identifies the glass as a *calix*. "We drink out of a glass; you from a murrine, Ponticus. Why? Lest a transparent goblet reveal the two kinds of wine." Clement of Alexandria (*S.* 2/3)^{21a} inveighs against the elaborately carved drinking vessels. In the Digest²² we read that "glass vessels for eating and drinking are to be considered in the class of household goods, just as earthenware vessels are, not only the common ones, but also those that are more costly." In a procession of Ptolemy Philadelphus two gold mounted glasses were carried.²³ The emperor Tacitus "was greatly pleased by the diversity and elaborate workmanship of glass cups."²⁴ But the emperor Gallienus "always drank out of gold cups; he despised a glass,

¹⁸ IG 2, 645: ὑάλιον ἀργυροῦγ κο[ίλον] Note: "Boeckh, in quibus fortasse emendandum est ὑαλι(ν)ον." 2, 646, 4: ὑαλινο[ν ἄ] | ργυροῦν, σταθμ[ὸν] ΓΙΙΙ. 2, 656, 18: ὑάλινον ἀργυροῦν, σταθμ[ὸν] τούτου ΓΙΙΙ. Sen. *de Ira*, 1, 12, 4: si vitreum fractum est. See above, p. 149, n. 35^a; p. 106, n. 34. Alex. Aphrod. *Problem.* 1, 119: διὰ τί τὰ ὕελα ἐν τῷ χειμῶνι θερμοῦ σφόδρα τινὸς ἐμβληθέντος, ῥήγνυνται. *Dig.* 33, 7, 12, 28: Ulpianus libro vicesimo ad Sabinum. proinde si fundus sit instructus legatus, et supellex continebitur, quas illic fuit usus ipsius gratia . . . mensae quoque eboreae vel si quae aliae: item vitrea et aurum et argentum. Evagr. (*Patr. Gr.* 40, 1284B): vitrum cadens a saxo comminetur. *Origo Rom. Chron.* 145, 17: vitria. 146, 3: vitrea fracta. Hier. *Epist.* 125, 16, 1: in vitro et patella fictili aurum comeditur. *Corp. Gloss. Lat. s. v. yalina.* vitria. *yala.* vitria. Possibly Suid. *s. v. ὑέλιον. καὶ ὕελος. καὶ ὑέλινον.* See above, p. 88, n. 38 (the translation given in *Corp. Script. Byz.* 9, 661, 14, is: vitra Heliopolitana XVII.)

¹⁹ See above, p. 136, n. 25.

²⁰ See above, p. 110, n. 36; p. 111, n. 38.

²¹ 1, 37, 2: bibis vitro. 4, 85, 1: nos bibimus vitro, tu murra, Pontice. quare? | prodat perspicuus ne duo vina calix.

^{21a} See above, p. 109, n. 24.

²² 33, 10, 3, 3 (Paulus): vitrea escaria et patoria in supellectili sunt, sicut fictilia, nec solum vulgaria, sed etiam quae in pretio magno sunt.

²³ Athen. 5, 30: καὶ κυλικεῖα δύο καὶ ὑάλινα διάχρυσα δύο.

²⁴ Flav. Vopisc. *Tac.* 11, 3: ipse fuit vitae parvissimae . . . vitreorum diversitate atque operositate vehementer est delectatus.

because nothing was more common, he said."²⁵ The glass mentioned in a papyrus of the fourth century, although at first taken as an instrument for clipping coins, may be perhaps simply a glass to hold the wine.²⁶ The Vulgate translation of Proverbs, 23, 31,²⁷ runs, "Do not look upon the wine . . . when its color shineth in the glass." This shows that in the fourth century the typical cup was a 'glass,' although the Hebrew and the Greek say nothing about a glass in this passage. Possibly the same use of a glass is to be found in one of the Apocryphal Gospels.^{27a} Valerianus (*S.* 5)²⁸ mentions a glass as a drinking cup. Isidore (*S.* 6/7)²⁹ speaks of how well anything shows through a glass.

Seneca (*S.* 1) tells of the magnifying power of glass, especially a glass filled with water: "apples appear much larger to those looking at them through a glass,"³⁰ and "apples seem more beautiful if they are floating in a glass."³¹

It was evidently the style among certain society people to go to the excess of watching the death of the mullet which they were to eat. Seneca³² speaks of this, "and now we hear: 'there is nothing more beautiful than one dying; let me hold in my hand the glass in which it jumps and quivers.' " Pliny³³ also, on the word of the epicures, describes the changing colors of the dying mullet as seen through a glass.

²⁵ Treb. Pollio, *Gall. Duo*, 17, 5: bibit in aureis semper poculis aspernatus vitrum, cum diceret, nil esse communius.

²⁶ See above, p. 29, n. 30.

²⁷ Nec intuearis vinum quando flavescit, cum splenduerit in vitro color eius. Cf. the Greek version of this passage: ἐὰν γὰρ εἰς τὰς φιάλας καὶ τὰ ποτήρια δῶς τοὺς ὀφθαλμοὺς σου, ὥστερον περιπατήσεις γυμνότερος ὑπέρου,

^{27a} Apocryphal Gospels, (ed. Michel-Peters in *Textes et Documents*, 1, Paris (1911), *Hist. of Joseph*. (Coptic and Arabic from Greek original of *s.* IV according to Stern, or later according to Peters). Peters translates: "un verre d'eau," ch. 1 (Coptic and Arabic), ch. 26 (Arabic), ch. 31, 32 (Coptic).

²⁸ *Homil.* 10, 2: huic denique manducanti barba vellitur illi bibenti sedilia subtrahuntur, hic ligno scissili, ille fragili vitro pascitur.

²⁹ *Orig.* 16, 16, 1: in vitro vero quilibet liquor vel species qualis est interius talis exterius declaratur, et quodammodo clausus patet.

³⁰ *Nat. Quaest.* 1, 3, 9: poma per vitrum aspicientibus multo maiora sunt.

³¹ *Id.* 1, 6, 5: poma formosiora quam sunt videntur, si innatant vitro. See below, p. 159, n. 61; p. 182, n. 26.

³² *Id.* 3, 18, 4: at nunc audimus: 'nihil est moriente formosius; da mihi in manus vitreum in quo exsultet et trepidet.'

³³ *N. H.* 9, 66: mullem exspirantem vericolori quadam et numerosa varietate spectari proceres gulae narrant, rubentium squamarum multiplici mutatione pallescentem, utique si vitro spectetur inclusus.

Pliny³⁴ records that glass was employed as a receptacle for preserving grapes.

Aside from its use in cups, glass served also as a container for cooling drinking water. "It was a device of the Emperor Nero to boil water and put it in a glass into the snow to cool."³⁵

In medical writers there is also frequent mention of glass vessels.^{35a} Sometimes they speak of a particular type of vessel, sometimes of a glass vessel, and often simply of a glass.³⁶ 'A glass' is frequently mentioned by alchemical writers in very much the same way.^{36a}

Glass was used for wine bottles. Martial (*S.* 1)³⁷ writes of "dark Falernian stored away in a little glass."

The perfume bottle was also called a glass. Martial³⁸ says,

³⁴ *Id.* 14, 17: *conduntur et musto uvae ipsaeque vino suo inebriantur; aliae decocto in musto dulcescunt, aliae vero subolem novam in ipsa matre expectant tralucidae vitro.*

³⁵ *Id.* 31, 40: *Neronis principis inventum est decoquere aquam vitroque demissam in nives refrigerare.*

^{35a} See above, p. 152, n. 7; below, p. 180, n. 11.

³⁶ *Plin. N. H.* 28, 173: *in vitro servata.* *Scrib. Larg. Comp.* 63, 110: *vitro reponitur.* 145: *medicamentum vitro condunt.* 175: *vitro reponitur (vitro vel vitreo vase, Rhod.).* *Celsus, de Med.* 7, 18: *et tamquam in vitro cornuve per scrotum apparet.* *Galen,* 13, 42: *ὑάλω.* 13, 290: *ἐν ὑέλῳ.* *Orib.* 61, 2: *χρήσαιοι δὲ ἄν τις καὶ ταῖς ὑελαῖς, ἐπὶ ᾧ κατανοεῖν χρή τὴν κένωσιν τοῦ αἵματος.* *Rufus (Daremborg-Ruelle, 569): ἀποτίθεσο λεία ἐν ὑέλῳ.* *Interpolator in Dioscorides lib: 1 Parabil. cap.* 170: *βαλὼν αὐτὸ εἰς ὑάλην, καὶ κρέμασον εἰς ἥλιον* (quoted from Du Cange, 2, 47).

^{36a} *Isis ad Horos,* 13 (*Berthelot, Collection,* 32): *βαλὼν ἐν ὑελίνῳ τὰ πέταλα.* *Democritus,* 3 (*Berthelot, Collection,* 55): *πρῶτον κάθαιρε ὑελον.* *Zosimus,* 4 (*Berthelot, Collection,* 175): *ἐν ὑάλινους.* *Idem,* (*Berthelot, Collection,* 247): *ἐν ὑέλοις βλέπης τὸ γινόμενον.* *Berthelot, Collection,* 333, 43: *καὶ κάτωθεν βάλε ὑελον ἄλλον . . . θές αὐτὸν τὸ δυνατόν ὑδωρ ἐνδον ἐν ὑελίῳ ἐν θερμοσποδιᾷ.* 361, 34: *εἷτα ἔμβαλε τοὺς λίθους ἐν ὑάλῳ.* 364, 1: *ἔμβαλε αὐτὰς ἐν ὑάλῳ . . . κρέμασον τὸν τοιοῦτον ὑαλον . . . καθ' ὥραν δὲ λάμβανε τὸν τοιοῦτον ὑαλον.* 365, 3: *ἀνάσπασον ἐν ὑάλοις.* 366, 3: *καὶ οὕτω μίαν ἐκάστην τῶν τοιούτων σφαιρῶν ἐμβαλὼν ἐν ὑάλῳ . . . κίνει αὐθις ντῷ ὑάλῳ.* 366, 4: *καὶ ἐμβαλὼν ἐν ὑάλῳ . . . εἷτα ἔμβαλε ἐκάστην σφαῖραν χαλαροειδῆ ἐν ὑάφῳ βικοειδεῖ.* 368, 2: *ἔμβαλε εἰς ὑάλινον.* 384: *κατάλειπε πλεον τοῦ ἐκκαλεῖν τὸ ὑέλινον . . . ῥήγνυνται τὸ ὑέλινον.* 389: *βάλε εἰς ὑελον.* 390: *ἐνθαψον αὐτὸ φίλοσ-όφως ὑέλῳ.* *Lib. Sac.* 93 (*Berthelot, Hist.* 1, 204): *item talch, in vitro aut forti panno . . . suspensum.* 175 (*Hist.* 1, 221): *in fornace vitreorum.* Other vessels mentioned by the alchemist are to be found above, p. 153, n. 17^{a-b}; below, p. 158, n. 52; p. 169, n. 150; p. 170, n. 151^a; p. 175, n. 202, 203, 208 ff. See also *Manget, Bibl. Chem.* 1, 302, 307, 332, 346, 372, 442, 470, 496, 499, 502, 540; 2, 548, 559, 561, 643, 645, 653, 654, 656, 08, 659, 685, 699, 758; 3, 35, 81, 84, 85, 706.

³⁷ 2, 40, 6: *conduntur parco fusca Falerna vitro.* *Reinach (Rev. Archéol.* 2 (1919), 238) tells of small portions of ancient wine preserved in glass bottles. So, also, *Berthelot, Hist.* 1, 380 ff.

³⁸ 3, 55, 2 (1): *quod quacumque venis Cosmum migrare putamus | et fluere excusso cinnama fusa vitro.*

"Whenever you come, we think Cosmus is migrating, and that his glass is broken and the cinnamon perfume has spilled out and is flowing about." Antiphilos (*S.* 1)³⁹ speaks of spikenard in a glass, to be used as perfume for the hair.

Philostratus (*S.* 2/3)⁴⁰ tells about a fiery worm from which an oil is rendered, that gives off such a flame that nothing but a glass can hold it. Sulpicius Severus (*S.* 4)⁴¹ speaks of Saint Martin blessing some oil which increased until there was no room left in the glass. Gregory of Tours (*S.* 6)⁴² also tells of oil in a glass increasing at the tomb of a saint. The *Geoponica* (*S.* 10)⁴³ claim that a glass is better than anything else to keep oil in.

Claudius Claudianus (*S.* 4)⁴⁴ in writing of Archimedes' sphere says, "When Jupiter saw the heavens in a little glass, he laughed."

Jerome (*S.* 4/5)⁴⁵ in describing the administration of the Eucharist says, "The blood (of Christ) was carried in a glass;" hence a glass chalice must have been no uncommon thing in his time.^{45a}

4. *Lesbion* (*Lesbian Cup*). Athenaeus (*S.* 2/3)⁴⁶ in speaking of the *Lesbion* says, "This is a kind of cup; Hedylos [*S.* III] proves it in his *Epigrams* where he says: 'Kallistion in a drinking contest with men

³⁹ *Anth. Pal.* 6, 250: καὶ ἐς κυανότριχα χαίτην | νάρδον, ὑπὸ γλαυκῆς κλειομένην ὕαλον. Quoted in Suid. *s. v.* νάρδος (ὕαλης reading of MSS. B. E.).

⁴⁰ *Vita. Ar.* 3, 1: τοῦτο οἱ τήκοντες ἔλαιον ποιοῦνται, πῦρ δὲ ἄρα τοῦ ἐλαίου τούτου ἐκδίδονται καὶ στέγει αὐτὸ πλὴν ὑελοῦ οὐδέν.

⁴¹ *Dial.* 2 (3), 3, 2: in vitro illo spatium non fuisse. Cf. Venant. Fortunat. *Vita S. Martin.* 4, 350. *Id.* 4, 84: ne vitra depereant, olei custodia servat.

⁴² *De Miraculis S. Mart.* 2, 32: tamen puer qui aderat cum vidisset factum, accepto vasculo, ipsam terram experimens parumper olei elicit, rosamque quae effusa fuerat, cum effracto vitro colligens, nobis exhibuit.

⁴³ 9, 19, 10: κάλλιστα γὰρ φυλάξει τὸ ἔλαιον ὑέλως, ψυχρὰ φύσις οὔσα.

⁴⁴ *Carm. Min.* 51, 1 (68): in sphaera Archimedis. Iuppiter in parvo cum cerneret aethera vitro, | risit. For what was possibly a similar contrivance, see above, p. 55, n. 15.

⁴⁵ *Epist.* 125, 20, 4: nihil illo ditius, qui Corpus Domini canistro vimineo, sanguinem portat in vitro. Cf. Frigidodus, *de Vita S. Wilfridi*, 54 (*Patr. Lat.* 133, 1010): vimeno condens corpus Kyriale canistro | exhausit vitro vitalem digne cruorem.

^{45a} Babington in Smith's *Dict. of Christian Antiq.* (1880), 730. Plummer, *Vitae Sanct. Hibern.* 1 (1910), CXXXVII: "We hear of altar vessels of glass." Note 6: "Glass chalices have been found in the catacombs, *Archaeology and Authority*, p. 414. A legend of a glass altar in Keating. iii, 106."

⁴⁶ 11, 486B (Kaibel (1890)): Δέσβιον ὅτι ποτηρίου εἶδος, 'Ἡδύλος παρίστησιν ἐν Ἐπιγράμμασιν οὕτως λέγων· ἡ διαπινομένη Καλλίστιον ἀνδράσι, θαῦμα | κοῦ ψευδές, νῆστις τρεῖς χόας ἐξέπινεν· | ἥς τότε σύ, Παφίη, ζωραῖς μύρρησι θυωθὲν | κεῖται πορφυρέης Δέσβιον ἐξ ὑέλου. Cougny, *Anth. Gr. Append.* (1890), cap. 1, no. 115, adopts Jacobs' correction ζωραῖς μέτροισι.

(it is marvelous, but true), when fasting drank three *choes*. From which, O Paphian, she offers you this Lesbian of dark glass.' " It was an engraved cup.⁴⁷

5. *Skeuos* (*Vessel, Ware*). *Skeuos* is a general term denoting not only a vessel, but as we have already seen wares in general.⁴⁸ When used to designate a vessel, the nature of the glass is seldom revealed;⁴⁹ the term glass *skeuos* was used to designate a vessel for medicine,⁵⁰ for food and drink,⁵¹ for preserving,⁵² for the concoctions of the alchemist,^{52a} and as a definition for an *alabastron*.⁵³

6. *Trublion* (*Bowl*). Strabo (*S. I*)⁵⁴ tells that at Rome many ways had been discovered for facilitating the manufacture of glass, improving the colors, and making transparent glass so that it was possible to buy a *trublion*, 'bowl' or 'cup,' and *ekpomation*, 'little goblet,' for a very small sum.

7. *Ekpomation* (*Little Goblet*).⁵⁵

⁴⁷ Paul. Diac. (Lindsay (1908), 102): Lesbian genus vasis caelati a Lesbiis inventum.

⁴⁸ See above, p. 149b, n. 34^a-34^b. One is reminded of the above passages in a record of the defraudation of Dioscorides and Sarapammon in Wesseley, *Corp. Papyr. Hermanopolitan*. (*Stud. z. Pal. u. Papyruskunde*, 5, 9, 6ff.): καὶ σκεῦη ποικίλα ὑέ[λεα | . . . δακτυ | λίων πολυτίμων καὶ | . . .

⁴⁹ Philodemos, *de Mort.* 39, 4 (1ff.): καὶ τοὶ τὰ πάθ[η] τ[αὐ]τὰ διαφέρειν οὐκ ἄν τις | εἴπειε το[ῦ] ν[ο]ῦ | μίξειν ὑαλινὰ καὶ κεραμεῖα σκεῦη | συγκρούοντα παμπόλ-
λ[ο]υ[ς] χρόν[ο]ν | ἀδαμαντίνους ἀκάτακτα διαμέ|νει <ν>. Photius (*Patr. Gr.* 277 A): οὐκ ἄγνωῶ δέ τις (ξύλα, καὶ λίθους) τὰ ξύλινα σκεῦη, καὶ λίθινα ἐξειληφότας· οἷς ἱκανὸς ἔλεγχος ἦ τε τῶν ὀστράκων, καὶ τοῦ ὑέλου. Nemes. *de Nat. Hominis* (*Patr. Gr.* 40, 665A): καὶ λαβὼν ὑέλινα σκεῦη, ἐπὶ τε τὰς θυρίδας ὀρμήσας, ἥρῳτα τοὺς παριόντας, ἕκαστον τῶν σκευῶν ἐξ ὀνόματος καλῶν, εἰ θέλουσιν αὐτὸ ριφῆναι κάτω. *Actus Petri cum Simone*, 30: ἦ τις γεννηθεῖσα οὔτε ἀργυρέῳ ποτὲ σκεύει ἐχρήσατο οὔτε ὑελῶ, εἰ μὴ μόνοις χρυσέοις.

⁵⁰ Galen, 5, 838: ἡ τοῖς σκεύεσιν ὑαλίνους . . . χρῆσθαι. 11, 875: ἐπὶ τῶν ὑαλίνων σκευῶν. 14, 268: τὴν ἀντίδοτον εἰς ὑάλινα ἢ ἀργυρᾷ σκεῦη. 14, 293: ἐν ὑελίνους σκεύεσιν. Paul. Aeg. 7, 115: εἰς ἀργυρᾷ ἢ ὑέλινα σκεῦη. *Idem*, 7, 14. 1: καὶ τότε καταγγίξεν ἐν ὑαλίνους σκεύεσιν. Theophan. Nonn. *Epi. t. de Curatione Morborum*, 105: ἔπειτα κόψας, σείσας, φύλαττε ἐν ὑελίνῳ σκεύει καὶ χρῶ.

⁵¹ See above, n. 3.

⁵² *Georon*. 9, 19, 11: εἰ δὲ μὴ ἔχεις ὑέλινα σκεῦη, εἰς καινὰ κεράμια βεβαμμένα ἐνδοθεν γύψῳ ἢ ἀμόργῃ ἔμβαλε.

^{52a} Olympiodorus (Berthelot, *Collection*, 105): τὰ δὲ προσμελανισθέντα ὕδατα ἔμβαλε ἐν σκεύει τινὶ ὑελίνῳ. Zosimus, 3 (*Collection*, 175): ἀναμαλάξαντες πάντα ἐν ὑαλίνους σκεύεσιν. *Idem*, 15 (*Collection*, 201): ὅτι τὰ σκεῦη τῶν συνθεμάτων ὑαλινὰ χρῆ εἶναι.

⁵³ See below, n. 197.

⁵⁴ See above, p. 55, n. 13.

⁵⁵ *Idem*.

8. *Supellex* (*Household Utensils, Service*). We have been speaking of general terms for vessels and of particular vessels of glass, but now Propertius (*S. I*)⁵⁶ uses a collective word *supellex* to include the various vessels necessary for a drinking party. There was "a summer service of glass." Perhaps glass was considered lighter and cooler looking than metal vessels for the hot summer season. Celsus (*S. 2*)⁵⁷ uses *supellex* in a still wider sense to include any household utensil. We have already noted the number of instances where the Roman law included glass under household goods rather than in the category of precious stones.⁵⁸

9. *Murra, Murrina* (*Murrines*).⁵⁹

10. *Crystalla, Crystallina* (*Crystal Ware*).⁶⁰

11. *Pila* (*Globe*). Seneca (*S. I*)⁶¹ speaking of the fact that objects look larger through water says, "Letters, however small and indistinct, appear larger and clearer through a glass globe (*pila*) full of water". Pliny⁶² in discussing glass says that "it cannot endure heat unless a cold liquid is put in first; yet, when glass globes full of water are held to the sun, they become so bright that they burn clothing," where the action of the globe in concentrating the sun's rays is spoken of as though it were an increase of brightness in the glass and water themselves.—No form could be more easily blown. There are other references to globes which are not called *pilae*,⁶³ and another reference to *pila* with the meaning ball.⁶⁴

12. *Olla* (*Jar*). We have noted before that in the times of most extravagant luxury, about the middle of the first century after Christ, the death of a mullet was sometimes watched at a banquet.⁶⁵

⁵⁶ 4, 8, 57: Lugdamus ad cyathos, vitrique aestiva supellex | et Methymnaei Graeca saliva meri.

⁵⁷ *Dig.* 33, 10, 7: nam fictili, aut lignea, aut vitrea, aut aerea denique supellectili utebantur.

⁵⁸ See above, p. 83, n. 32^a, p. 90, n. 31–32; p. 92, n. 46; p. 154, n. 18; p. 154, n. 22.

⁵⁹ See above, p. 83ff.

⁶⁰ See above, p. 79ff.

⁶¹ *Nat. Quaest.* 1, 6, 5: litterae quamvis minutae et obscurae per vitream pilam aqua plenam maiores clarioresque cernuntur. See above, p. 155, n. 30, 31; below, p. 182, n. 26.

⁶² *N. H.* 36, 199: est autem caloris impatiens, ni praecedat frigidus liquor, cum addita aqua vitreae pilae sole adverso in tantum candescant, ut vestes exurant.

⁶³ See above, n. 44; below, p. 174, n. 192; p. 179, n. 8–10.

⁶⁴ See below, p. 184, n. 5.

⁶⁵ See above, p. 155f.

Seneca⁶⁶ in disgust writes, "A mullet does not seem fresh enough unless it dies in the hand of a banqueter; they are passed around enclosed in glass jars (*ollae*), and their color is watched while they expire." Pelagonius (*S.* 5)⁶⁷ speaks of a glass *olla* as a receptacle for medicine.

13. *Poculum* (*Cup*). There are but a few references, as far as I know, to a glass *poculum* (*poculum vitro*),⁶⁸ but the number is greatly increased if we include the murrine^{68a} and crystalline cups.⁶⁹

14. *Vas, Vasum* (*Utensil*). Another very general term for a vessel is *vas*, 'utensil.' Seneca⁷⁰ explains that a body will receive heat more quickly and retain it longer in proportion to its solidity, as is shown by a copper vessel in comparison with those of glass and silver. And this is typical of the vagueness of the ordinary employment of the term, since it is frequently impossible to identify the style and type of the vessel referred to. As noted, Pliny⁷¹ in speaking of crystal, which so often makes one think of glass, states: "Xenocrates affirms that a vessel with the content of an amphora (six gallons, seven pints) has been seen, and others that from India a vessel of four sextars (three quarts)." Murrine vessels were used for holding food when served on the table.⁷² It is not uncommon to find life compared to a glass vessel.⁷³ In the translation of an ex-

⁶⁶ *Nat. Quaest.* 3, 17, 2: parum videtur recens nullus nisi qui in convivae manu moritur; vitreis ollis inclusi afferuntur et observatur morientium color.

⁶⁷ 18: repone in olla vitrea. It was also used by the alchemist, Manget, *Bibl. Chem.* 2, 643.

⁶⁸ Verse written to the right of the picture of a boy drinking from a glass bowl on Barb. Fol. 19 (see Strzygowski, *Jahrb. des Archäol. Inst. Ergänzungsheft*, 1 (1888), Taf. XXVI); *Carm. de Mens.* 395 (*Anth. Lat.* 1, 1, 310): fontanos latices et lucida pocula vitro | cerne ut demerso torridus ore bibat | aeterno regni signatus nomine mensis, | Latona genitam quo perhibent Hecaten.

^{68a} See above, p. 87, n. 14; p. 89, n. 24-26; 90, n. 29-30; p. 91, n. 36.

⁶⁹ See above, p. 82, n. 26; p. 90, n. 30, p. 91, n. 36.

⁷⁰ *Nat. Quaest.* 4, 9: accedit his ratio Democriti: 'omne corporis quo solidus est, hoc calorem citius concipit, diutius servat. itaque si in sole posueris aeneum vas et vitreum [et argentium], aeneo citius calor accedet, diutius haerebit. The reading in *Nat. Quaest.* 3, 18, 4, *vas vitreum*, is of course only a gloss.

⁷¹ See above, p. 79, n. 3.

⁷² *Dig.* 37, 18: escariisque vasis expetitis.

⁷³ See above, p. 107, n. 38. Cf. above, p. 74f.; below, n. 92. Cf. Rabanus Maurus, *de Universo*, 17, 10: vitrum autem quod baptismatis sacramentum significet, in quo abluimur ab omni sorde peccatorum et puritati restituimur, iam superius dictum est. unde in Apocalypsi ita scriptum de structura civitatis supernae: ipsa vero civitas aurum mundum similis vitro mundo (Apoc. XXI) . . . vitrum autem ad fidem veram retulit; quia quod foris videtur, hoc est et intus; et nihil simulatum est et non perspicuum in sanctis ecclesiae. potest et ad illud tempus referri, quo sibi invicem cogitationes in alterutrum perscipiuntur et declarantur.

periment described by Philon a glass vessel is mentioned.⁷⁴ As we have already seen, glass vessels were very useful for holding medicines,⁷⁵ and the alchemist's preparations.^{75a} Bede (*S.* 7/8)^{75b} speaks of glass as being well adapted for vessels of various uses. In requesting a glassmaker Cuthbert (*S.* 8)^{75c} asks the archbishop of Mainz concerning someone who is skilled in making *vitrea vasa*.

Pliny⁷⁶ relates a curious superstition in this connection. In telling of the remedies for eye troubles he says that some people catch a green lizard, put out its eyes, and place it, together with some rings, in a glass vessel, where one may observe through the glass when the lizard regains its sight. It is then freed, but the rings are kept for use against inflammation of the eyes.

Pliny⁷⁷ also tells of obsidian glass which is used for dishes. We have seen that according to the Digest murrines were not to be classed as gems,⁷⁸ but glass, crystalline, and murrine vessels for

⁷⁴ See above, p. 78, j.

⁷⁵ Plin. *N. H.* 21, 122 (121): aut cum detractis unguibus reliqua pars aut oleo aut vino maceratur in sole vasis vitreis. Scrib. Larg. *Comp.* 106: reponitur medicamentum vaso vitreo. 108: reponitur vitreo vaso. 111: reponitur medicamentum in vitreo vase. 121: vitreo vase servatur. 122: in vase vitreo mundo reponuntur. 125: vitreo vaso servatur. 170: reponitur vitreo vase. 173: vase vitreo antidotus reponitur. 175: vitreo reponitur (vitro vel vitreo vase, Rhod.) Gargil. Mart. *Med.* (Keil, *C. Plin. Caecil. Secund. Epist.* (1886), 41): medicamentum salubriter vitreo vaso servatur. 43: haec sicco die ante meridiem lecta et linteolo mundiore purgata vitreo vaso immittuntur. 212: reponis in vaso vitreo. Plin. *Secund. Jun. de Med.* 1, 6: servatur in vitreo vase. 2, 4: servatur in vaso vitreo (*ter*). 2, 26: in vitreo vaso recondi. 3, 37: in vaso vitreo ponuntur. Galen, 14, 486: vitreo vase (in old Latin translation). Marcell. *de Med.* 14, 57: servantur vaso vitreo. Orib. *Synop.* 3 (in old Latin translation, Bussemaker-Daremberg, 5 (1873), 887, 188): lento igni coquis et in vaso reponis. 6 (1876), 51, 6: probatur enim lactes et hoc modo: mittimus igitur partes octo in vasu vitreo. Veg. *Mulomed.* 1, 16, 5; 6, (4), 13, 3: in vase vitreo vel stagneo servabis. 1, 17, 15: in pulverem redigas et tritum vitreo vase custodias. 3, 11, 2: post in vase stanneo vel vitreo reconditum servas. 3, 13, 2: huius Chiron talem compositionem saluberrimam credidit . . . haec omnia pariter conteres et diligenter in vase vitreo servas. Paul Aeg. 3, 6: sine infundi in vase vitreo per dies XX movens.

^{75a} *Liber Sacerdotum*, 2: in vase vitreo. 85: in vase vitreato pones. 178: mitte in vase vitreo. 185: reponere in vase vitreo. 190: sublima eum in vase vitreato. 199: pone in vasis vitreis. Berthelot, *Hist.* 1, 157: vas vitrum sublimationis mercurii. See Manget, *Bibl. Chem.* 1, 87, 91, 282, 286, 291, 292, 302, 332, 442, 470, 496, 499, 503, 540; 2, 558, 563, 579, 643, 644, 647, 649, 650, 654, 658, 681, 685, 699, 703, 705, 706.

^{75b} See above, p. 113, n. 7b.

^{75c} See above, p. 114, n. 7c.

⁷⁶ *N. H.* 29, 130: alii terram substernunt lacertae viridi excaecatae et una in vitreo vase anulos includunt e ferro solido vel auro. cum recepissee visum lacertam apparuit per vitrum, emissa ea anulis contra lippitudinem utantur.

⁷⁷ See above, p. 145, n. 14.

⁷⁸ See above, p. 90, n. 32.

food and drink were considered among the household goods.⁷⁹ There is an old translation of the *Acts of Peter* which tell of a very rich woman "who was called Chryse because all her vessels were of gold; she had never used a vessel of silver or glass, but only of gold,"⁸⁰ which would indicate that at the time when this apocryphal work was written (*S.* 3), glass ware although it might still be classed with silver was distinctly less valuable than gold. Murrines and crystalline vessels could still be classed with gold and silver.⁸¹ Isidore⁸² in repeating the story of malleable glass and the fate of its inventor says, "For if glass *vasa* were not breakable, they would be something better than gold and silver." Theophilus (*S.* 11/12) describes the making of *vitrea vasa*.^{82a}

Glass *vasa* were also useful in preserving things. Columella (*S.* 1)^{82b} goes into great detail in describing glass pickle jars. He says that they do not need to be so large, but you should have a number of them; some should be coated with pitch, others not; they should be made to order, not bulging like a *dolium*, but straight up and down so that the pickles can be easily weighted down. The use of glass as a container for oil has been noted previously.⁸³ Palladius (*S.* 4)⁸⁴ in describing the Greek method of making oil says that it should be put into glass *vasa*. Sulpicius (*S.* 4)⁸⁵ narrates a miracle

⁷⁹ See above, p. 90, n. 31; p. 83, n. 32^a.

⁸⁰ *Act. Petri cum Simone*, 30: et obstetrix quaedam, honesta femina, quae cognomen habebat Crysis propter quod omnem vasum aureum possideret, quae neque argenteo vaso neque vitreo utebatur, sed omnia aurea.

⁸¹ See above, p. 90, n. 33.

⁸² See above, p. 111, n. 38.

^{82a} 2, 10. Compare the coloring of *vitrea vasa* in *Liber Sacerdotum*, 112, 126.

^{82b} *De Re Rust.* 12, 4, 4: vasa autem fictilia vel vitrea plura potius quam ampla et eorum alia recte picata, nonnulla tamen pura, prout conditio exegerit. haec vasa dedita opera fieri oportet patenti ore, et usque ad imum aequalia, nec in modum doliorum formata ut exemptis ad usum salgamiis quidquid superest aequali pondere usque ad fundum deprimatur.

⁸³ See p. 153, n. 14; p. 157, n. 40-43; 164, n. 96.

⁸⁴ *De Re Rust.* 12, 17: de oleo faciendo secundum Graecos . . . in vitrea vasa transferri.

⁸⁵ *Dial.* 2 (3), 3, 4: vas vitreum cum oleo, quod Martinus benedixerat, in fenestra paululum editiore deposuit: puer familiaris incautior linteum superpositum, ampullam ibi esse ignorans, adtraxit. Cf. Venant. Fortunat. *Vita S. Martin.* 4, p. 350. *Idem*, 4, 54: vas olei vitreum lance aequa dimidiatum, | unde salutifero depelleret unguine morbum. | mox super ampullam fecit crucis ipse sigillum, | surgit ad ora liquor spumansque exaestuat unguen | ubertate nova vitrea sub cortice obortum, | et vase in sicci generosus nascitur humor. 4, 72: idem vas vitreum benedictum nobile reddens. 6, 5, 365: vitreo cum vase cadente.

in connection with the *vas* (here called also *ampulla*) of sacred oil blessed by Saint Martin. It was carelessly pushed out of the window, and fell to the pavement below, but was found uninjured.

15. *Amphora*. The *amphora* was usually a large vessel, with two handles, but it also designated a bottle or flagon. Petronius⁸⁶ writes, "Immediately glass *amphorae* carefully sealed with gypsum were brought in, to the necks of which were fastened tags with the label: 'Opimian Falernian one hundred years old.' " That the *amphorae* were made of glass is probably to be taken as a mark of ostentation at this time, since we have seen above that a glass vessel which held an *amphora*, liquid measure, was regarded as one of extraordinary size.⁸⁷

16. *Phialê, Phiala, Fiala (Cup, Shallow Wine-Cup)*. Petronius,⁸⁸ followed by Isidore,^{88a} tells the story of the workman who made the *phiala*, 'shallow wine-cup,' of flexible or malleable glass. Pausanias (*S.* 2)⁸⁹ describes a picture by Pausias in which Drunkenness is represented as drinking from a glass *phialê*; "in the picture you see the glass drinking-cup and through it the woman's face." A picture of this type occurs for the month of August in a calendar of the year 354; a boy is drinking from a large bowl through which his chin can be seen distinctly.^{89a} Theodoret (*S.* 5)⁹⁰ lists *phialai* among the numerous vessels of glass. Four glass drinking cups of this type are mentioned in an index of dedicated objects in an inscription of Cos.⁹¹ This vessel is mentioned in alchemical works.^{91a} The Latin form *fiala*⁹² occurs but seldom to my knowledge.

17. *Ampulla, Ampoulla (Little Jar)*. *Ampulla* is explained as an irregular diminutive of *amphora*. Theophilus (*S.* 11/12) describes

⁸⁶ 34, 6: statim allatae sunt amphorae vitreae diligenter gypsatae, quarum in cervicibus pittacia erant affixa cum hoc titulo: 'Falernum Opimianum annorum centum'

⁸⁷ See above, p. 79, n. 3.

⁸⁸ See above, p. 110, 36.

^{88a} See above, p. 111, n. 38.

⁸⁹ See above, p. 135, n. 9.

^{89a} Strzygowski, *op. cit.* 73 and Taf. XXVI of Barb. Fol. 19 (see above, n. 68).

⁹⁰ See above, n. 3.

⁹¹ Paton and Hicks, *The Inscr. of Cos.* (1891), 36; Ditt. *Syll.* (1920), 734, 153: *ἰνέθηκα δὲ καὶ ὑαλῖνα[s | φιά]λας τέσσαρας καὶ χλανίδ[α ἀλου]ργάν.*

^{91a} Berthelot, *Collection*, 368, 4: *λεῦκωσις μαργαρίτων.—καὶ βάλε εἰς φιάλην ὑαλίνην.* Niceph Blemm. 3, 4 (*Collection*, 453): *βάλε εἰς φιάλην ὑέλιον.* Manget, *Bibl. Chem.* 1, 291, 302, 307, 332; 3, 706.

⁹² Hier. *Epist.* 24, 2: praetermitto, quod in matris utero benedicatur ei, antequam nascatur, quod in fiala nitentis vitri et omni speculo purioris patri virgo traditur per quietem. Heraclius, 1, 5.

the making of long-necked *ampullae*.^{92a} The uses ascribed to the glass *ampullae* are: a receptacle for medicine,⁹³ a drinking-cup,⁹⁴ part of a table service,⁹⁵ an oil container,⁹⁶ and the vessel which received the water and blood from the pierced side of the Lord.⁹⁷

18. *Calix (Cup)*. There are few instances where *calices* of glass are actually mentioned, but there are a number of instances where the cups may well have been *calices* of glass. Pliny⁹⁸ tells of two moderate-sized *calices* called *petroti*. In a passage which has caused much comment⁹⁹ Juvenal (*S.* 1/2)¹⁰⁰ writes, "You will drain your four nozzled cup, bearing the name of Beneventum's cobbler, which is now cracked and demanding sulphur for its broken glass." This cobbler has been identified with Vatinius,¹⁰¹ which may be the reason why the Vatinian cups mentioned by Martial¹⁰² are sometimes considered to have been made of glass. Martial¹⁰³ mentions embossed cups of glass. Apuleius (*S.* 2)¹⁰⁴ describes a number of

^{92a} 2, 11: de ampullis cum longo collo.

⁹³ Plin. *N. H.* 20, 152: magna societas cum hac ad recreandos defectos animo puleio, cum surculis suis in ampullas vitreas aceti utrisque deiectis. Scrib. Larg. *Comp.* 42: reponitur medicamentum ampulla vitrea. A similar use is found in alchemical literature, Manget, *Bibl. Chem.* 1, 307, 538; 2, 643; 3, 81; Ps.-Apul. *Herb.* 30, 131.

⁹⁴ Mart. 6, 35, 3: at tu multa diu dicis vitreisque tepentem | ampullis potas semisupinus aquam. | ut tandem saties vocemque sitimque, rogamus | iam de clepsydra, Caeciliane, bibas. Possibly 14, 110: ampulla potiora. hac licet in gemma servat quae nomina Cosmi, | luxuriose, bibas, si foliata sitis.

⁹⁵ Porph. on Hor. *Serm.* 1, 6, 117: adstat echinus vilis cum patera. echinum Lucilius sic dixit quasi scorteae ampulla sit, ut cum ait echinus cinnabari infectus. hic tamen vitream ampullam intellegere debemus.

⁹⁶ Sulpicius Sev. *Dial.* 2 (3), 3, 2: ampullam vitream istiusmodi fuisse, ut rotunda in ventrem cresceret ore producta, sed oris extantis concavum non repletum, quia ita moris sit vascula complere, ut pars summa umbonibus obstruendis libera relinquatur. Cf. Venant. Fortunat. *Vita. S. Martin.* 4, 54, 349. Jacob. Gretser. on Georg. Codinus, 1, 10 (*Patr. Gr.* 157, 164): porro voculam *ampulla* etiam Graeci fecerunt suam ἀμπουλα vel ἀμπουλλα. Aetius, 1, 7: ἀμπουλλαν ἐκλίνην πλήσας ἐλαίου.

⁹⁷ Athanasius (*Patr. Gr.* 28, 822A): et supponentes ampullam vitream ad locum vulneris, receperunt in eam aquam et sanguinem de latere Domini decurrentem.

⁹⁸ See below, n. 117.

⁹⁹ See above, p. 101, n. 31.

¹⁰⁰ 5, 48: tu Beneventani sutoris nomen habentem | siccabis calicem nasorum quattuor ac iam quassatum | et rupto poscentem sulphura vitro.

¹⁰¹ Friedlaender (1895) on *Juv. loc. cit.*

¹⁰² 10, 3, 4: quae sulphurato nolit empta ramento | Vatiniorum proxeneta fractorum. 14, 96: calices Vatinii. vilia sutoris calicem monumenta Vatinii | accipe; sed nasus longior ille fuit.

¹⁰³ See above, p. 109, n. 24.

¹⁰⁴ *Met.* 2, 19: ampli calices variae quidem gratiae, sed pretiositatis unius. hic vitrum fabre sigillatum ibi crystallum in punctum.

large, costly cups of various designs, some of which were of glass with engraved figures. It is not strange that glassware should be mentioned in the Roman law, for it was handed down from one generation to another. Augustine (*S.* 4)¹⁰⁵ in speaking of the shortness of human life asks, "Are we not frailer than if we were glass?" "For," he adds, "even if glass is fragile, yet, if cared for, it lasts a long time, and you find grandsons and great-grandsons drinking out of the cups of their grandfathers and great-grandfathers. Such fragile objects have been preserved throughout the years." The last recorded use of a glass *calix* that I have found occurs in the *Life of Saint Hilarius* (*S.* 5).¹⁰⁶

Since Egypt was one of the great glass manufacturing centers, there is always the possibility of cups from there being of glass. When Martial¹⁰⁷ says, "Boy, take away the cups and embossed work of the tepid Nile," it is more than likely that he is thinking of glass *calices*. This conjecture is supported by other passages. In one instance when speaking of common cups, he calls them *toremata* (engraved work) of glass;¹⁰⁸ in another on glass cups he says, "You behold the genius of the Nile; alas, how often has the workman ruined his work while greatly desiring to add to it."¹⁰⁹ When jewelled *calices* are mentioned,¹¹⁰ there is always the possibility that the gems are of glass. Murrine¹¹¹ and crystalline *calices*¹¹² have been mentioned previously. Gallienus in a letter to Claudius mentions Aegyptian cups¹¹³ which might very well have been of glass. In a letter from Hadrian to Saturninus¹¹⁴ the emperor alludes to the

¹⁰⁵ *Sermo*, 18, 7 (*Patr. Lat.* 38, 128): *vitae brevitatis homo vitro fragilior. nonne fragilior sumus, quam si vitrei essemus? vitrum enim etsi fragile est, tamen servatum diu durat: et invenis calices ab avis et proavis, in quibus bibunt nepotes et pronepotes. tanta fragilitas custodita est per annos.*

¹⁰⁶ 8, 11 (*Patr. Lat.* 50, 1230): *numquidnam poterit aestimari quantum visceribus eius insederit pietas, qui usque eo credidit omnia distrahenda, quousque ad patenas vel calices vitreos veniretur?*

¹⁰⁷ See above, p. 109, n. 24.

¹⁰⁸ *Ibidem*.

¹⁰⁹ 14, 115: *calices vitrei. | aspicias ingenium Nili: quibus addere plura | dum cupit, oh quotiens perdidit auctor opus!* The workman's responsibility in this matter has been noted in the Digest, see above, p. 119, n. 35.

¹¹⁰ 14, 109: *calices gemmati. | gemmatum Scythicis ut luceat ignibus aurum, | aspice. quot digitos exiit iste calix.*

¹¹¹ See above, p. 90, n. 34-35.

¹¹² See above, p. 82, n. 25; p. 90, n. 35; below, n. 116, 119.

¹¹³ Treb. Poll. *Claud.* 17, 5: *calices Aegyptios.*

¹¹⁴ Vopisc. *Saturn.* 8, 10: *alii vitrum conflant . . . calices tibi allassontes versi-*

fact that the Egyptians blow glass; then he goes on to say that he is sending as gifts certain *calices*, variously shaded *alassontes*, i. e., changeable, or iridescent glass goblets. The Digest (533 A.D.)¹¹⁵ mentions an engraved cup (*diatretus calix*). The crystalline *calix* which Gregory of Tours (*S.* 6)¹¹⁶ describes as being broken and miraculously restored was probably of glass.

19. *Petrotus* (*Cup*). Pliny¹¹⁷ briefly relates the story of the flexible glass and the effort to keep glass from usurping the place of the precious metals. "But what good did it do?" he asks. "Since under the emperor Nero the art of glass-making had been so perfected that two moderate-sized drinking-cups, which they called *petroti*, sold for six thousand sesterces." The word *petrotos* is rather difficult to explain. In the early editions of Pliny it was written *pterotos*. The root of *petrotos* has something to do with a rock.¹¹⁸ The question is whether the word is an adjective describing the cups, or whether it is the name for certain cups which perhaps looked like rock crystal.

20. *Skyphos* (*Goblet*). Pliny¹¹⁹ tells of Nero breaking two crystalline drinking cups when he heard that his fortune was hopeless. Suetonius (*S.* 2)¹²⁰ refers to the same story when he writes, "He upset the table and dashed to the floor two favorite *scyphi* which he called 'Homeric' from the Homeric tales carved on them." It looks very much as if these cups might have been of glass. Lucian (*S.* 2)^{120a} uses *ekpoma* and *skyphos* synonymously. According to Athenaeus (*S.* 2/3),¹²¹ Epinicus (*S.* III) writes of old Thasian wine being mixed

colores transmissi, quod mihi sacerdos templi obtulit, tibi et sorori meae specialiter dedicatos, quos tu velim festis diebus conviviiis adhibeas.

¹¹⁵ See above, p. 110, n. 27.

¹¹⁶ *De Glor. Martyr.* 1, 46 (*Patr. Lat.* 71, 747-8): est enim apud eanden urbem basilica sancti Laurentii levitae, cuius supra meminimus, ibique admirabili pulchritudine calix crystallinus habetur. acta vero quadam solemnitate, dum per diaconum ad sanctum altare offerretur, elapsus manu in terram ruit, et in frusta comminutus est . . . denique in vigiliis, lacrymis, atque oratione deducta nocte, requisitum calicem reperit super altare solidatum.

¹¹⁷ *N. H.* 36, 194: sed quid refert, Neronis principatu reperta vitri arte, quae modicos calices duos quos appellabant petrotos, H S VI venderet?

¹¹⁸ *Harper's Lat. Dict. s. v. petrotos*. Bostock and Riley (1893): "*petroti* (stone handled) or *pterotos* (with winged handles)."

¹¹⁹ See above, p. 79, n. 3.

¹²⁰ *Nero*, 47: mensam subvertit, duos scyphos gratissimi usus, quos Homericos a caelatura carminum Homeri vocabat, solo inlitis.

^{120a} See above, n. 6.

¹²¹ See above, p. 20, n. 4.

with honey in a *skyphos* of 'molten stone,' the old Greek expression for glass. Theophilus^{121a} (*S.* 11/12) describes the decoration of glass *scyphi* with gold or silver leaf.

21. *Trulla* (*Ladle*). Pliny gives the account that Petronius, when he was at the point of death, broke a murrine *trulla*, 'ladle,' no doubt for wine bowls, which he had purchased at an exorbitant price.¹²² A crystalline *trulla* was bought by a woman who was not at all wealthy for a hundred and fifty thousand sesterces.¹²³

22. *Capis* (*Bowl with One Handle*). Pliny tells us that Pompey dedicated murrine *capides* to Jupiter Capitolinus from the triumph commemorating his victory in the East. This was the first introduction of murrines into Rome. Nero paid one million sesterces for a single murrine *capis*.¹²⁴

23. *Dolium* (*Jar*). Columella (*S.* 1)¹²⁵ says to put up alissander and skirret-roots in an earthenware or glass *dolium*, 'globular jar with a wide mouth.' This vessel was also used for medicine.¹²⁶

24. *Fidelia* (*Pot*). Another vessel mentioned by Columella¹²⁷ for use in preserving is a glass *fidelia*, 'pot.' A gloss¹²⁸ on *fidelia* explains it as a glass vessel.

24^a. *Diatreta* (*Carved Vessels*).¹²⁹

25. *Nimbus* (*Cup*). Martial (*S.* 1)^{129a} puns on the glass *nimbus*: "the *nimbus* (rain-storm) which comes from Jupiter will pour down a great abundance of water for mixing your cups; this *nimbus* (cup) will give you the wine."

25^a. *Toreumata* (*Vessels Carved in Relief*).¹³⁰

^{121a} 2, 13-14: de vitreis scyphis, quos Graeci auro et argento decorant.

¹²² See above, p. 87, n. 14.

¹²³ See above, p. 79, n. 3.

¹²⁴ See above, p. 87, n. 14.

¹²⁵ *De Re Rust.* 12, 56, 3: tum in dolio picato fictili vel in vitreo componito.

¹²⁶ Veget. *Mulomed.* 6 (4), 13, 3; Pelagonius . . . in pyxide vel vitreo dolio condis.

¹²⁷ *De Re Rust.* 12, 58, 1: caeterum medullam eius concisam in fideliam vitream, vel novam fictilem conicito.

¹²⁸ See above, n. 12. *Harper's Lat. Dict.* is at fault in calling *fidelia* unequivocally 'an earthen vessel, pot,' and taking no cognizance of the fact that it was also of glass.

¹²⁹ See above, p. 109.

^{129a} 14, 112: nimbus vitreus. | a Iove qui veniet, miscenda ad pocula largas | fundet nimbus aquas: hic tibi vina dabit.

¹³⁰ See above, p. 109.

26. *Priapus* (*Cup of Obscene Shape*). In enumerating the excesses of the day Pliny^{130a} says that man takes pleasure in drinking from vessels of obscene form. Juvenal (*S.* 1/2)¹³¹ mentions one of these cups, a glass *priapus*. Another vulgar name for the same was *drillopota*.

27. *Poterion* (*Drinking Cup*). The mention of a glass *poterion*, 'drinking cup,' occurs first in Epictetus (*S.* 1/2).¹³³ In *The True History* Lucian (*S.* 2)¹³⁴ describes a banqueting place on the Elysian Plain: "About the symposium there are large glass trees of transparent glass and the fruit of these trees is cups of all kinds." Dio Cassius (*S.* 2)¹³⁵ tells the story of the cup of malleable glass, calling it a *poterion*. The passage in which Athenaeus (*S.* 2/3) speaks of many different shapes of *poteria* being made in Alexandria has already been quoted.¹³⁶ The Sidonian cups mentioned by Athenaeus¹³⁷ have been said to have been of glass because Sidon was noted for its glass,¹³⁸ but the context shows pretty clearly that it is shape and not material which is here the characteristic feature ("Others, again, explain it ('i. e. figured') as meaning, having figures like fingers engraved all round it; or having small projections, like the Sidonian cups; —or, again, some interpret the word as meaning merely smooth"—Yonge). In discussing glass *ekpomata* mentioned by Aristophanes in the *Acharnians* some of the later lexicographers call them *poteria*.¹³⁹ A scholiast commenting on Lucian¹⁴⁰ where he mentions a cup made by Mentor, adds that Mentor was a glass smelter. The word occurs also in a rather difficult inscription from Cos.¹⁴¹ The Thericlean cup is sometimes explained as a glass *poterion*.¹⁴²

^{130a} *N. H.* 33, 4: didicit homo naturam provocare. auxere et artem vitiorum irritamenta; in poculis libidines caelare iuvat ac per obscenitates bibere. Kisa, *op. cit.* 772, n. 2, gives: "auxere et artes vitiorum irritamenta."

¹³¹ 2, 95: vitreo bibit ille priapo. *Schol. Juv.* 2, 95: ille priapo. in vitreum penem. quos appellant drillopotas. Cf. *Mart.* 14, 70 (69): priapus siligineus.

¹³³ 3, 24, 84: οἶον δάλινον ποτήριον.

¹³⁴ 2, 14: ἀλλ' ἔστι δένδρα περὶ τὸ συμπόσιον δάλινα μεγάλα τῆς διαναγεστάτης δάλου, καὶ καρπὸς ἔστι τῶν δένδρων τούτων ποτήρια παντοῖα καὶ τὰς κατασκευὰς καὶ τὰ μεγέθη.

¹³⁵ See above, p. 111, n. 37. For other accounts where different designations were used, see above, p. 110, n. 36; 111, n. 38.

¹³⁶ See above, p. 130, n. 20.

¹³⁷ 11, 468C: ἄλλοι δὲ τὸ ἐν κύκλῳ τύπους ἔχον οἶον δακτύλους, ἢ τὸ ἔχον ἐξοχὰς οἶα τὰ Σιδώνια ποτήρια, ἢ τὸ λεῖον.

¹³⁸ Blümner, *Term. u. Tech.* 4, 381, 3.

¹³⁹ See above, p. 36, n. 17.

¹⁴⁰ See above, p. 114, n. 8.

¹⁴¹ See above, p. 40, n. 47f.

Although the *poterion* was ordinarily a drinking cup, it was occasionally used for other purposes. Thus Damascius (*S.* 9)¹⁴³ mentions a cup filled with water in connection with certain mantic rites, resembling our 'crystal gazing.' The *Geoponica* (*S.* 10)¹⁴⁴ recommend a glass cup covered with wax for preserving figs. A glass cup was handy also for the preparation of a medicine.¹⁴⁵ Clear glass *poteria* were used in the process of coloring gems.^{145a}

28. *Catinus* (*Deep Bowl*). Suetonius (*S.* 2)¹⁴⁶ tells about Galba hastening to Tusculum to offer expiatory sacrifices because of a dream. He had sent men ahead to make preparations, but "he found on the altar nothing but warm ashes and beside it an old man dressed in black holding the incense in a deep glass bowl (*catinus*) and the wine in an earthenware cup."

29. *Pinakion* (*Little Dish*). In an inventory of household goods from a papyrus of the early part of the second century after Christ two glass *pinakia*, 'little dishes,' are listed.¹⁴⁷

30. *Angos* (*Vessel*). *Angos* refers to a vessel of any description. The glass *angoi* which are mentioned were used for medicines,¹⁴⁸ for ripening citrons,¹⁴⁹ and for the preparations of the alchemist.¹⁵⁰

¹⁴² See below, p. 173, n. 185.

¹⁴³ *Patr. Gr.* 103, 1289 A: ὕδωρ γὰρ ἀκραιφνὲς ἐγχέασα ποτηρίῳ τινὶ τῶν ὑαλίνων, ἑώρα κατὰ τοῦ ὕδατος εἴσω τοῦ ποτηρίου τὰ φάσματα τῶν ἐσομένων πραγμάτων καὶ προύλεγεν ἀπὸ τῆς ὕψεως αὐτὰ, ἅπερ ἐμελλεν ἐσεσθαι πάντως.

¹⁴⁴ 10, 56, 6: ἕτεροι ἕλινον ποτήριον, ἢ τι ἄλλο τῶν διαφανόντων, ἐπικαταστρέφουσι τοῖς σύκοις πράως, περιπλάττοντες κηρῷ παραπνοήν μὴ ἀπολείποντες, καὶ παραμένει ἀμάραντα.

¹⁴⁵ Demetrius, *Hier.* 222: κλήματα ἀμπέλου καύσας ἐν καθαρῷ τόπῳ καὶ τέφραν ποιήσας βάλε εἰς ποτήριον ὑέλινον καὶ ὕδωρ καὶ ποίησον στακτήν . . . καύσας κλήματα ἐν τόπῳ καθαρῷ θὲς τὴν τέφραν αὐτῶν ἐν ποτηρίῳ ὑελίνῳ μετὰ ὕδατος καὶ ποίησον κατασταλάκτην.

^{145a} Berthelot, *Collection*, 353, 9: χρὴ δὲ γενέσθαι πᾶσαν βαφήν ἐν ὑαλίνους ποτηρίοις λαμπροῖς.

¹⁴⁶ *Galba*, 18, 2-3: nihil invenit praeter tepidam in ara favillam atratumque iuxta senem in catino vitreo tus tenentem et in calice fictili merum.

¹⁴⁷ *P. Lond.* 2, 191, 16: πινακία νελα δύο.

¹⁴⁸ Galen, 13, 97; 13, 745: εἰς ἄγγος ὑελοῦν. 13, 1010; 14, 568: εἰς ἄγγος ὑέλινον. Theophan. Nonn. 1, *de Capillis Fluentibus*: ἕα ταῦτα βρέχεσθαι εἰς ἄγγος ὑέλινον ἡμέρας κ'.

¹⁴⁹ *Geopon.* 10, 7, 6: ὁ δὲ καρπὸς τοῦ κιτρίου, πρὶν τέλεον αὐξήσαι, ἔαν εἰς ἄγγος κεραμεοῦν ἢ εἰς ὑέλινον ἐντεθῇ, αὐξανόμενος τυπωθήσεται πρὸς τὸ ἀγγεῖον, καὶ τοσοῦτος γενήσεται, ὅσον καὶ τὸ τοῦ ἀγγείου μέγεθος.

¹⁵⁰ Berthelot, *Collection*, 250: εἰ μὲν διὰ ὑελίνων ἀγγῶν ἐψοῦνται τὰ θειώδη, ἀναγκαῖον χρῆσασθαι τοῖς φωσίν οἷς κέχρηται οἱ σκιογράφοι, εἰ τίς ἐστι κηροτάκις. ἀναγκαῖον οὖν τὸ ἄγγος τὸ ὑέλινον διὰ πηλοῦ κεραμικοῦ ἐπιδερματίδα <ἔχειν> ἡμιδακτυλαίαν. 313, 59: βαλὼν εἰς ὑελοῦν ἄγγος. 368, 6: ἐμβαλὼν εἰς ἄγγος ὑάλινον. 385, 1: βαλὼν τὴν σκουρίαν εἰς ὀστράκινον ἢ ὑέλινον ἄγγος.

31. *Pyxis* (*Case, Small Box*). A *pyxis* was a box-shaped vessel which could be used for holding medicine,¹⁵¹ and chemical compounds.^{151a}

32. *Skeuarion* (*Small Vessel*). A glass *skeuarion*, 'small vessel,' diminutive of *skeuos*, sometimes occurs in medical writings.¹⁵²

33. *Vasculum* (*Small Vessel*). *Vacula*, 'small vessels,' of glass are mentioned a few times by medical writers.^{152a} Soranus (*S.* 2)¹⁵³ describes one in the form of a pierced nipple, obviously intended to insure very slow drinking.

34. *Pinax* (*Dish, Platter*). Athenaeus (*S.* 2/3),¹⁵⁴ in giving Hippolochos' report of a marriage feast, tells of a glass *pinax*, 'platter,' of two cubits in diameter on a silver stand,¹⁵⁵ served full of fish of every description.

35. *Amis* (*Urinal*). The glass *amis*, 'urinal,' is a matter of scorn with Clement of Alexandria (*S.* 2/3),¹⁵⁶ but of course not so among medical writers.¹⁵⁷

36. *Lagynos* (*Flask*). In the Oxyrhynchus papyri there is a letter of the second or third century from a man to his sister announcing the dispatch of various articles, among them "a bread-

¹⁵¹ Galen, 13, 30: εἰς πυξίδα ἀργυρᾶν ἢ ὑελίνην. 13, 104: εἰς πυξίδα ὑελίνην ἢ ἀργυρᾶν. Pelagon. 426: reponis in pyxide vitrea. See above, n. 126; below, n. 162.

^{151a} *Chemistry of Moses*, 4 (Berthelot, *Collection*, 301): καὶ ὅταν ψυγῇ καλῶς, βάλε εἰς πυξίδα ὑελίνην.

¹⁵² Galen, 13, 1057: εἰς ἀργυροῦν σκενᾶριον ἢ ὑελοῦν παχύ. Soranus (*Ideler, Phys. et Med.* 1 (1841), 248, 2): ῥωγμὴ μὲν οὖν ἐστὶν ἀπλὴ ῥῆξις ὅστέου παραπλησία ταῖς ὀρωμένοις ἐπὶ τῶν ὑέλων σκευαρίων.

^{152a} Marcell. *de Med.* 20, 126: in vasculo vitrio recondes. 36, 72: in vitreo vasculo reponentur.

¹⁵³ *Gyn. Vet. Trans. Lat.* 131 (Rose (1882), 43, 5): quid ei bibere dabimus? aliquando aquam aliquando vinum aquatius per vasculum vitreum ad similitudinem papillae formatum et pertusum, quod rustici ubuppam appellant aut titinam.

¹⁵⁴ Athen. 4, 129D: καὶ μετὰ τὸν πότον ὑελοῦς πίναξ διπηχὺς ποῦ τὴν διάμετρον ἐν θήκῃ κατακείμενος ἀργυρᾷ πλήρης ἰχθύων ὀπτῶν πάντα γένη συνηθροισμένων.

¹⁵⁵ Glass stands were also in use, see below, n. 165.

¹⁵⁶ *Paedag.* 2, 4, 39: χλεῦθ δὲ καὶ γέλως πλατὺς οὐροδόχας ἀργυρᾶς καὶ ἀμίδας ὑελᾶς ἐπιφέρεισθαι τοὺς ἀνδρας. *Schol.* 180, 28: εἰ μὲν τρυφῆς χάριν, καλῶς· εἰ δὲ ἀναγκαίης χρείας καὶ διὰ νόσον, ὡς ἂν διαγινώσκοιτο τῷ ὑάλῳ τὸ νόσημα, οὐκ εἰκότως ἐπέσκωψας. See above, p. 92, n. 47.

¹⁵⁷ Joan. Act. *de Urinis*, 2, 32, 21: αἱ τοίνυν ἀμίδες ἔστωσαν ἐκ λευκῆς μὲν πάννυ καὶ λεπτῆς ὑέλου κατεσκευασμέναι, ἵνα ἀκριβῶς τὰ χρώματα διαφαίνηται. 2, 33, 7: εἰς δ' ἐπιτρηδεύτηα ἐπιτηρήσεως οὕρων ἡττον ἂν λυσιτελεῖν τῶν λοιπῶν τῶν ἀμίδων, αἱ δὲ κατὰ τὸ σχῆμα τοῖς ὑελίνοις τοῦτοις ἐκπώμασιν ἑοίκασιν, οἷς δῆτα χρώμεθα οἱ πίνοντες, ὥστε, εἰ δέοι καὶ τὰ μάλιστα λυσιτελοῦντα σχήματα τῶν ἀμίδων μαυθάνειν, τὰ τοιαῦτα μάλλον ἂν δόξειε λυσιτελέστατα. δεῖ γε μὴν τὰς ἀμίδας ταύτας μήτε ζῶναις περιδεῖν ἐξ ὑέλου ὡς ἐπιπροσθούσαις.

basket in which were four glass flasks (*lagynoi*) in sound condition."¹⁵⁸ Glass *lagynoi* are also mentioned in some accounts in the Papyri of the Fayûm town.¹⁵⁹

37. *Pleuron* or *Pleura* (*Rib*, or *Side*, ordinarily). This same account lists four glass *pleura*,¹⁶⁰ which must mean some sort of a glass vessel, although *pleuron* does not occur elsewhere with such a meaning.

38. *Doliolum*, *Doleolum* (*Small Jar*). A glass *doliolum*, the diminutive of *dolium*, 'jar,' is used in the preparation of food,¹⁶¹ and as a receptacle for medicine.¹⁶²

39. *Vitreamina* (*Glassware*). The word *vitreamina*, 'glassware,' has already been discussed under the Latin designations for glass.¹⁶³ It is interesting to note the importance of glassware in Roman law.¹⁶⁴

40. *Puthmên* (*Hollow Bottom or Stand of a Cup*). Among vessels might well be listed the *puthmên*, 'the hollow bottom or stand of a cup.' These stands were made of glass¹⁶⁵ as well as metal.¹⁶⁶

41. *Kylix* (*Wine Cup*). Although the Roman authors not infrequently mention a glass *calix*,^{166a} the *kylix* of glass very seldom occurs in Greek. In Caesarius (*S.* 4)¹⁶⁷ the glass mentioned is identified with a *kylix*. Maecius¹⁶⁸ writes of a fisherman dedicating a glass

¹⁵⁸ *P. Ox.* 13, 10, 1294: πανάριον ἐν ᾧ ὑάλοι λαγυνοὶ δ' ὕγειαί.

¹⁵⁹ *P. Fay.* 104, 1-2: λαγύνων ὑελῶν μειακ[ρῶν].

¹⁶⁰ *Ibid.*: πλευρῶν ὑελῶν δ'.

¹⁶¹ Apic. Cael. *de Re Coquinaria*, 1, 13: ut uncia lasaris toto tempore utaris: lasar in spatiosum doliolum vitreum mittis et nucleos [pineos ut puta] viginti cumque utendum fuerit lasare, nucleos conteres.

¹⁶² Marcell. *de Med.* 7, 52: et simul commaceratum in doleolo vitrio repones utendum. 20, 92: recondes sub signaculo in pyxide buxea aut in doleolo vitreo. 36, 73: vitreo doliolo reponetur. Cass. Fel. *de Med.* 78 (Rose (1879), 184, 10, 6): diligenter conficies et in doliolo vitreo repones. Veget. *Mulomed.* 6 (4), 13, 3: pixidem vel vitreum doliolum condas C.

¹⁶³ See above, p. 66, e.

¹⁶⁴ Dig. 33, 7, 18, 13: Paulus libro secundo ad Vitellium quidam cum ita legasset: villam meam ita ut ipse possedi cum supellectile . . . cum in diem mortis ibi libros et vitreamina et vesticulam habuerit, an eadem omnia legato cederent, quoniam quaedam enumerasset, Scaevola respondit, specialiter expressa, quae legato cederent.

¹⁶⁵ Hippolytus, *Elenchos*, 4, 35, 2: ἡ λεκάνη τὸν μὲν πυθμένα ἔχει ὑαλοῦν.

¹⁶⁶ See above, p. 170, n. 154.

^{166a} See above, p. 164, no. 18.

¹⁶⁷ Dial. 1, 68 (*Patr. Gr.* 38, 4, 936): παγῆναι δὲ αὖθις κρύσταλλον, καὶ ἀνέχειν τὸ ἡμισυ τῶν ὑδάτων οἶον ἐπὶ τῆς ὑάλου ἔστιν ἀθρῆσαι, ἐξ αὐτῆς ἐκείνην διαπεφραγμένην τὴν κύλικα, καὶ ἀποκρίνουσαν διχῶς τὸ ἐκχεόμενον.

¹⁶⁸ *Anth. Pal.* 6, 33: ἰδ' ὑαλὴν οἰνοδόκον κύλικα.

wine cup, and Theodoret (*S.* 5)¹⁶⁹ mentions cups of this type among the numerous vessels made of glass. Zonaras (*S.* 12) speaks of a crystalline *kylix* (see page 55).

42. *Sikya* (*Cupping Glass*). A glass *sikya* 'cupping-glass,' named from its gourd-like shape, is mentioned twice in Greek medical writers.¹⁷⁰

42^a. *Orbis* (*Globe*).^{170a}

43. *Drillopota* (*Cup of Obscene Shape*).¹⁷¹

44. *Patena* (*Saucer, Low Bowl*).¹⁷²

45. *Alassontes* (*Cups of Changeable Color*).¹⁷³

46. *Oenophorum* (*Wine Jar*). The only mention of a glass *oenophorum*, 'wine-jar,' is in Pelagonius (*S.* 5).¹⁷⁴

47. *Amphoriskos* (*Small Amphora*).¹⁷⁵

48. *Bombylos* (*Narrow-Necked Vessel*).¹⁷⁶

50. *Epipla* (*Furniture, Ware*).¹⁷⁷

50^a. *Caliclus* (*Little Cup*).^{177a}

51. *Therikleion* (*Cup*). There was a type of cup called Thericlean. Athenaeus says that "this cup is hollowed out considerably at the sides and has flat lugs like the *kylix*."¹⁷⁸ Later he adds, "A certain cup is called a Thericlean *crater*,"¹⁷⁹ and cites many authors to show the use of this cup.¹⁸⁰ Athenaeus also gives the explanations of the name which were then current. "Thericles, a Corinthian potter, is said to have made this cup and it took its name from him."¹⁸¹

¹⁶⁹ See above, n. 3.

¹⁷⁰ Antyllus in Orib. *Collect. Med.* 7, 16 (Bussemaker-Daremberg, 2 (1854), 60, 13): παρὰ δὲ τὴν ὕλην διαφοραὶ εἰσι σικυῶν τρεῖς, ὑελαῖ, κεράτιναι, χαλκαῖ. Paul Aeg. 6, 41, 2: ἕτεροι δὲ σικύαις ὑαλίνοις ἐχρήσαντο διὰ τὸ τὸ ποσὸν τοῦ κενωμένου αἵματος ἐν τῇ ὀλκῇ διανυγῆσθαι.

^{170a} See below, p. 179, n. 8.

¹⁷¹ See above, n. 131.

¹⁷² See above, n. 106.

¹⁷³ See above, n. 114.

¹⁷⁴ *Art. Vet.* 468: fundum oenophori vitrei in pulverem mollissimum redige.

¹⁷⁵ See above, n. 3.

¹⁷⁶ *Ibid.*

¹⁷⁷ *Ibid.*

^{177a} See below, p. 190, n. 5.

¹⁷⁸ 11, 470E: θηρίκλειος. ἡ κύλιξ αὕτη ἐγκάθηται περὶ τὰς λαγόνas ἱκανῶς βαθυνομένη ὥτ' αὖτε ἔχει βραχέα ὡς ἂν κύλιξ οὔσα.

¹⁷⁹ 11, 472A: καλεῖται δὲ τις καὶ θηρίκλειος κρατήρ.

¹⁸⁰ 11, 470E-472E.

¹⁸¹ 11, 470F: κατασκευάσαι δὲ λέγεται τὴν κύλικα ταύτην Θηρικλῆς ὁ Κορίνθιος κεραμεύς, ἀφ' οὗ καὶ τοῦνομα ἔχει. 11, 471B: Κλεάνθης δ' ἐν τῷ περὶ Μεταλήψεως συγγράμματι φησὶ· τὰ τοίνυν εὐρήματα καὶ ὅσα τοιαῦτα ἔτι καὶ τὰ λοιπὰ ἔστιν,

"Others narrate that the Thericlean cup was named from the skins of wild beasts (*theria*) being carved upon it.^{181a} And Pamphilus of Alexander, from Bacchus throwing the wild beasts (*theres*) into confusion by pouring libations out of these cups upon them."¹⁸² Bentley in a rather long discussion of the Thericlean cups accepts Thericles as their inventor, and adds, "After he had first invented them, they were called Thericlean from their shape, whatsoever artificer made them, and whether of earth, or of wood, or of metal."¹⁸³ More recently Miller has set forth his belief in the historicity of Thericles, the Corinthian potter of the latter half of the fifth century who gave his name to his most characteristic wares, especially a certain *kylix*.¹⁸⁴ He says that "Thericlean vases were various as to material, size, and purpose. They were made of earthenware, gold, silver, glass, or wood. They varied from comparatively small to titanic. They were, for the most part and characteristically, drinking cups."^{184a}

The *Therikleion* with which we are concerned in this study is a *potêrion*, 'cup.' A number of the later etymologists and lexicographers define the *Therikleion* as a glass cup (*potêrion*).¹⁸⁵ This definition can be hardly anything but a gloss upon a word, which, as was clear from the context, designated an object of glass. It may be noted that the first instance where a Thericlean is called a glass cup is in a gloss.

52. *Bêsion, Bêssion (Vessel)*. In describing the *lêkythos* Hesychius (*S. 5*)¹⁸⁶ speaks of it as a glass *bêsion*. In the same way the

οἶον Θηρίκλειος, Δεινιάς, Ἰφικρατίς· ταῦτα γὰρ πρότερον συνιστορεῖν τοὺς εὐρόντας. φαίνεται δ' ἔτι καὶ νῦν· εἰ δὲ μὴ ποιεῖ τοῦτο, μεταβεβληκὸς ἂν εἴη μικρὸν τοῦνομα. ἀλλὰ καθάπερ εἴρηται, οὐκ ἔστιν πιστεῦσαι τῷ τυχόντι.

^{181a} See Welcker, *Die Therikleia, mit Thierfiguren verzierte Becher* (*Rhein. Mus.* 6 (1839), 404ff.).

¹⁸² II, 471Bf.: ἄλλοι δ' ἱστοροῦσι θηρίκλειον ὀνομασθῆναι τὸ ποτήριον διὰ τὸ δορὰς θηρίων αὐτῷ ἐντετυπῶσθαι. Πάμφιλος δ' ὁ Ἀλεξανδρεὺς ἀπὸ τοῦ τὸν Διόνυσον τοὺς θῆρας κλονεῖν σπένδοντα ταῖς κύλιξι ταύταις κατ' αὐτῶν.

¹⁸³ *Works*, I (1836), 170, *Dissertations upon the Epistles of Phalaris*. Cf. Moeris (Pierson-Koch (1831), 139, note).

¹⁸⁴ *T. A. P. A.* 52 (1921), 122, 131; *P. A. P. A.* 58 (1927), xxiii.

^{184a} *Id.* 121.

¹⁸⁵ Kyrillos, Gloss (Hesych. ed. Schmidt, 4 (1864), 341): θηρίκλειον· ποτήριον ὕελινον. Photios: θηρίκλειον· ποτήριον ὕελινον. Bachmann, *Anecd. Gr.*; Suid. *s. v.* θηρίκλειον· ποτήριον ὕελινον. Zonaras, *Lex. s. v.* θηρίκλειον· ποτήριον ὕελινον. *Etym. Magn. s. v.* θηρίκλειον κύλικα· ποτήριον ὕελινον τὸ τοῦ Θηρικλέους ποτήριον.

¹⁸⁶ *S. v.* λήκυθος· τὸ μεταξύ τοῦ λαυκανίου (*Mus. Cod. λαυκαίου*) καὶ αὐχένος ἡχώδες· καὶ μυροθήκη, βήσιον ὕελινον.

alabastron is defined as a glass *bêsion*.¹⁸⁷ In another passage Hesychius¹⁸⁸ calls the *bêsion* a cup, but it seems to indicate simply a vessel, the precise form of which is to be inferred from the context. In the first instance *bêsion* designates a glass *lêkythos*; in the second, a glass *alabastron*, which were at times considered synonymous.¹⁸⁹

53. *Lêkythos* (Oil-flask). The description of a *lêkythos* as a glass vessel has just been noted. In a scholium on Aristophanes¹⁹⁰ there is a passage showing that *lêkythoi* might be of glass. In the time of the scholiast the glass dealer was still called *lêkythopolis*. At this time the dealers in small crockery, household wares, and the like, perhaps sold almost as much glass as anything else.

54. *Sphaera* (Sphere). Although spherical vessels have been mentioned under different designations,¹⁹¹ Fulgentius (*S.* 6)¹⁹² appears to be the only author to speak of a glass *sphaera*, 'sphere.'

55. *Urna* (Vessel). *Urna* is mentioned as part of a lamp.¹⁹³

55^a. *Ouriachos* (Spear, Shaft).^{193a}

[56. *Eubêkion* (Jar). Paulus Aegineta (*S.* 7)¹⁹⁴ mentions glass *eubêkia*, 'jars,' for holding balsam juice.]

57. *Bêkion* (Small Jar, or Bowl). A glass *bêkion* was used in the preparation of eye salve.¹⁹⁵ Perhaps it was the same as the *eubêkion* mentioned above. It has been suggested that *bêkion* is used for *bikion*.¹⁹⁶

58. *Alabastron* (Alabaster Vase, or Vessel). The *alabastron* is explained in the Etymologica as 'a vessel of glass'¹⁹⁷ or 'a glass *besion*'¹⁹⁸ (vessel) for holding unguents. A glass *alabastron* seems not to occur in literature.

¹⁸⁷ *Etym. Gud.* (De Stefani (1909), 78, 22): ἀλάβαστρον μύρον βησ(σ)ιον (βίσιον d 2) ἐστὶν ὑέλου. The Sturzius edition has βύγιον. *Cod. Neap.* 133, in Gaisford, *Etym. Mag.* (1848), 48, has βύσιον ἐστι, ὑέλου.

¹⁸⁸ *S. v.* βησ(σ)ιον ποτήριον.

¹⁸⁹ *S. v.* ἀλάβαστος λήκυθος.

¹⁹⁰ See above, n. 17.

¹⁹¹ See above, n. 44, 63; below, p. 179, n. 8-10; p. 177, n. 219.

¹⁹² See above, p. 58, n. 11.

¹⁹³ See below, p. 190, n. 7.

^{193a} See below, p. 191, n. 7^a-8; p. 190, n. 3.

¹⁹⁴ (Ed. Ald.) 132, 1: μετὰ δὲ ψυγῆναι ἐπιβάλλε τὸ ὀποβάλαμον καὶ καταγγίξε εὐβήκious ὑέλοις. But very likely this is an error for ἐν βικίος ὑέλοις (see *Corp. Med. Graec.* 7, 20, 33).

¹⁹⁵ Anon. in *Hippiatr. Vet. Med.* 1, 11, 46: καὶ ἀποτίθει εἰς βηκίον ὑάλινον. 1, 11, 48: ἀνελόμενος εἰς βηκίον ὑάλινον, ἢ κασσιτέρινον, ἔγχιριε.

¹⁹⁶ *Thes. Gr. Ling. s. v.* βικίον.

¹⁹⁷ *Etym. Gud.* (De Stephani), 78; *Cod. Neap.* 133, in Gaisford, *Etym. Mag.* 48: ἀλάβαστρον σκεῦός τι ἐξ ὑέλου (d' ὑελοῦ). *Etym. Magn.* 55, 36, adds: ἡ μυροθήκη.

¹⁹⁸ See above, n. 187, 189.

58^a. *Bygion (Vessel)*.^{198a}

59. *Bysion, byssion (Vessel)*.¹⁹⁹

59^a. *Bikion (Small Jar, or Bowl)*. The *bikion* was a glass vessel of some sort.^{199a} It was used for medical purposes,²⁰⁰ and the *Geoponica* (*S.* 10)²⁰¹ say that mulberries keep for a very long time in a glass *bikion*. The *bikion* was used by the alchemist also.²⁰² In one instance it is referred to as a glass *angeion arsenothêlu*, 'of two sexes,' called an *ambix*.²⁰³ This *bikion*, at least, seems to have consisted of two parts, designated as male and female respectively.

60. *Titina (Nipple)*.²⁰⁴

61. *Ubuppa (Nipple)*.²⁰⁵

62. *Bikos (Wine Jar, or Vessel)*. The word *bikos* occurs in several alchemical manuscripts.²⁰⁶ In the passages quoted, *bikoi* are mentioned as large; they are used as part of the apparatus for processes of sublimation and distillation. A *bikos* is also called a *bikion*; 'a glass' (*hyalos*) is described as *bikoeides*, 'like a *bikos*.'²⁰⁷

63. *Teuchos (Vessel)*. *Teuchos* may indicate a vessel of any kind. It occurs in an alchemical manuscript.²⁰⁸

^{198a} See above, n. 187.

¹⁹⁹ *Ibid.* Berthelot, *Collection*, 350, 3: ποίησον ζωμόν, καὶ ἔμβalon εἰς βυσσίον ὑάλινον κεχρισμένον πυριμάχῳ πηλῷ . . . ἔμβαλε εἰς τὸ βυσσίον τὸ πεπηλωμένον τὸ ἔχον τὸν ζωμόν.

¹⁹⁹ *Ibid.*

^{199a} *Thes. Gr. Ling.* s. v. βικίον.

²⁰⁰ *Anon. in Rhetor.* 3, 2 (Rabe (1896), 170, 12ff.): ποίαν γὰρ κοινωνίαν ἔξει τὸ ὑέλινον βικίον πρὸς ἄνδρα; ἢ ποίαν ἐγγύτητα ὡς ἐπονομάσαι ἄνδρα πυρίχαλκον τὸ ὑέλινον βικίον. Paul. Aeg. 7, 20 33: κατὰγγίξε ἐν βικίοις ὑελοῖς.

²⁰¹ 10, 69, 1: συκάμυνα δὲ ἐν ὑέλινῳ βικίῳ πλείστον διαμένει χρόνον.

²⁰² Olympiodorus, 1 (Berthelot, *Collection*, 105): βάλε ἐν βικίῳ ὑέλινῳ. Niceph. Blemm. 14 (*Collection*, 455): καὶ λαβὼν ἀμφότερα ἐν βικίῳ ὑέλινῳ. 18 (*Collection*, 456): θὲς αὐτὸ τὸ λευκανθὲν ἐν βικίῳ ὑέλινῳ.

²⁰³ Zosimus 1, see above, n. 17b. On ἀρσενόθηλυ, Berthelot, *Collection*, 143, note 3: "Formé de deux parties s'emboitant, dont l'une est regardée comme mâle l'autre comme femelle."

²⁰⁴ See above, n. 153.

²⁰⁵ *Ibid.*

²⁰⁶ Berthelot, *Collection*, 37, 1: καὶ ἔμβαλε αὐτὰ εἰς βικόν ὑέλινον. Zosimus, 5 (*Collection*, 226): συμπηλώσας τὰς συμβολὰς στέατι ἄρτου, ἔνθες ἐπὶ τὰ ἄκρα τῶν σωλήνων βίκους ὑέλινους μεγάλους. 14 (*Collection*, 234): βίκους ὑελεος, σωλήν ὀστράκινος μήκος πήχεως ἐνός. λωπὰς ἢ ἄγγος στενόστομον ἐν ᾧ ἡ σωλήνι τὸ πάχος βικίῳ τῷ στόματι αὐτοῦ. For a model, see *Collection*, 227, note 1. *Collection*, 236: ἔνθες ἐπὶ τὰ ἄκρα τῶν σωλήνων βίκους ὑελοῦς μεγάλους. See *Idem*, 229, n. 3.

²⁰⁷ See above, note 36a.

²⁰⁸ Dem. *ad Leucippos* 4 (Berthelot, *Collection*, 55): τότε νόει σε καλῶς ἔχειν τὴν λείωσιν [τοῦτο] ἀναλαμβανομένην (ἐν) Αἰγυπτίων προφήταις εἰς τεῦχος ὑέλινῳ.* *ὑέλινον Α. 5. βάλλε εἰς τεῦχος ὑέλινον.

64. *Organon (Instrument)*. In an alchemical manuscript containing a *Dialogue on Democritus* by Synesius (*S.* 4), there occurs the description of an apparatus having a glass instrument in the form of a little breast.²⁰⁹ Such an apparatus is figured in the manuscript.²¹⁰ As Berthelot suggests, there is a description of an alembic, once much used in distillation.²¹¹

65. *Mastarion (Breast-shaped vessel)*. See 64.

66. *Kythridion (Small pot, cup)*. A glass *kythridion*, called a *asympton* by Africanus, is mentioned as part of an apparatus for sublimation.²¹²

67. *Asympton (kythridion)*. See 66.

68. *Ambix, Ambyx (Cup, beaker)*. As mentioned above, the *anglion*, called an *ambix*, was also called a *bikion*.²¹³ *Ambix* occurs in other passages,²¹⁴ in one of which the author suggests using a glass *klokion* if you do not have an *ambix*.

69. *Troullos (Ladle, Cup)*.²¹⁵ The use of a large glass *troullous* is mentioned in an alchemical manuscript.²¹⁶

70. *Kybos (Cubical vessel)*. Glass *kyboi* were employed by the alchemist.²¹⁷

²⁰⁹ Berthelot, *Collection*, 60: ταύτη οὖν τῇ ἀναδόσει τοῦ πυρὸς, συναρμόζεται τῷ βωταρίῳ ὑέλινον ὄργανον ἔχον μαστάριον, ἐπὶ τὰ ἄνω προσέχον, καὶ ἐπικέφαλα κείσθω.

²¹⁰ *Idem*, 164, fig. 40.

²¹¹ *Idem*, *Trad.* 65, note 1.

²¹² Olympiodorus, 12 (Berthelot, *Collection*, 75): τὸ δὲ ἅλας ἐπενοήθη ἐκ τῶν ἀρχαίων, ἵνα μὴ κολληθῇ ὁ ἀρσένικος εἰς τὸ ὑελοῦν κυθρίδιον, ὅπερ ὑελοῦν κυθρίδιον ἀσύμποτον Ἀφρικανὸς ἐκάλεσεν. πηλοῦται τοίνυν ἡ κύθρα αὕτη, πηλῶ, ἥτοι φιάλῃ ἢ φανὸς ὑελοῦς αὐτῷ ἐπικείμενος. *Idem*, 82, n. 5: "Cette description répond à celle d'un appareil de sublimation, formé d'un récipient inférieur, surmonté de deux coupes ou chapiteaux, emboîtés l'un dans l'autre en forme d'aludel. Ce dernier appareil a été attribué aux Arabes; mais la description actuelle le fait remonter jusqu'à Africanus (III^e siècle). On lutait avec soin; et on condensait dans ces chapiteaux la partie sublimée." References to figures follow.

²¹³ See above, n. 17b.

²¹⁴ Ostanès, 2 (Berthelot, *Collections*, 262): καὶ μετὰ ταῦτα ἐν ὑέλινῳ ἄμβικι* ἐξωράϊσον ἐπτάκις. *ἄβυκη et audessus, en rouge; ἀγγεῖον Α (1^{re} main). Niceph. Blemm. 20 (*Collection*, 455): θὲς εἰς ὑέλινον κλοκίον μὴ ἔχον ἄμβικα.

²¹⁵ Compare the Latin *trulla*, number 21, above.

²¹⁶ Zosimus, 12 (Berthelot, *Collection*, 164): ἄλλοι ἐν τρούλλῳ μεγάλῳ ὑέλινῳ περιπηλώσαντες. Berthelot, *Trad.* 164, n. 1: "Troullos, mot à mot, truelle. C'est quelque instrument inconnu."

²¹⁷ *Idem*, 183, 6: τινὲς τῷ παντὶ ὀστράκῳ ἐν ὑαλοῖς κύβοις ἐψοῦσιν καὶ ὀπτῶσιν ἐπὶ τῆς κηροτακίδος· καὶ ταῦτα καλοῦσιν ληκύθια.

71. *Igdīs* (*Mortar*). In a treatise on the coloration of precious stones the use of a glass *igdis*, 'mortar,' is mentioned.²¹⁸

72. *Sphairion* (*Little Sphere*). The diminutive of *sphaira*, a 'globe' or 'sphere' occurs in a treatise on the coloration of stones.²¹⁹

73. *Thyeia* (*Mortar*). *Thyeia*, 'mortar,' as well as *igdis* (number 71), occur among the glass vessels mentioned in alchemical literature.²²⁰

74. *Patellion* (*Small Flat Dish*). The diminutive of *patella*, 'flat dish,' is used in describing an apparatus in which one glass *patellion* fits over the mouth of another.²²¹ In another passage a thick glass *patellion* is employed as a mortar with a glass *tribidion*, 'pestle?'²²²

75. *Tribidion* (*Pestle*). See 74.

76. *Troullion* (*Little Ladle, or Cup*). The diminutive of *troullos* (number 69) also occurs.²²³

77. *Oxybaphon* (*Shallow vessel*). A glass *oxybaphon* is classed with musical instruments in a treatise on music and chemistry.²²⁴

78. *Klokion* (*Vessel*). The *klokion* is mentioned in alchemical literature.²²⁵ It is recommended for use when an *ambix* is not at hand.

²¹⁸ Berthelot, *Collection*, 350, 2: λείωσον ἐν ἰγδῇ ὑαλίνῃ. 3: βάλε ἐκ τῶν σφαιρίων τούτων εἰς ἰγδὴν ὑαλίνην.

²¹⁹ *Idem*, 353, 10: περὶ οὗ καὶ ὁ θεσπέσιος λέγει Μωυσῆς ὁ προφήτης ἐν τῇ οἰκείᾳ χυμευτικῇ τάξει. "καὶ πάντα βαλὼν ἐν σφαιρίῳ ὑαλουργικῷ." See above, number 54.

²²⁰ *Idem*, 359, 24: καὶ λαβὼν ὑαλίνην θυεῖαν ἔμβαλε τὸ ὄξος.

²²¹ Salmanas, 2 (*Collection*, 365): ἔπειτα λάβε τὸ τοιοῦτον σύνθημα, καὶ ἔμβαλε αὐτὸ ἐν πατελλίῳ ὑαλίνῳ, καὶ ἐπιπώμασον τὸ τοιοῦτον πατέλλιον δι' ἐτέρου πατελλίου εὐρυστομωτέρου ὄντος, ὥστε περιλαμβάνεσθαι ὑπὸ τοῦ στόματος αὐτοῦ τὸ στόμα τοῦ κάτω πατελλίου. ἐχέτω δὲ τὸ ἐπάνω πατέλλιον ὁπῇ ἄνωθεν.

²²² *Idem*, 3(365): ἔγωσον ἐντὸς πατελλίου παχέως ὑαλίνου, ἀνατρίβων καὶ λειῶν καλῶς μετὰ τριβιδίου ὑαλίνου.

²²³ *Collection*, 422, 3: ὥς καὶ ἐν τρουλλίῳ τῷ ὑελώδει πλώματι. Note 6: τῷ ὑέλῳ διπλάσιον καὶ κατ' αὐτῷ Α.—καὶ (ὥς om.) ἐν ὑαλίνῳ ἀγγεῖῳ διαπλασίῳ σὺν τῷ αὐτοῦ τρουλλίῳ τίθεται καὶ ἐν αὐτῷ ἀφίεται Ε.—F.I. ὥς καὶ ἐν τρ. ὑέλῳ δίπλωμά τι

²²⁴ *Idem*, 438, 7: ναυστὰ δὲ καλοῦμεν ἢ κύμβαλα χειρῶν, ἢ ποδῶν, ὀξύβαφά τε χαλκὰ καὶ ὑέλινα. Note 14f.: "Réd. de E: ὥσπερ δὲ ἐν τῇ μουσικῇ, εἰσὶ πολλὰ τὰ γένη καὶ τὰ εἶδη καὶ τὰ ὄργανα, οὕτως εἰσὶ καὶ ἐν ταύτῃ τῇ θεῖᾳ τέχνῃ τῇ χυμευτικῇ γένη καὶ εἶδη καὶ διαφοραὶ οἰκονομιῶν καὶ συνθέσεων καὶ ἀγγεῖα καὶ ὀξυβ. καὶ χαλκὰ καὶ ὑέλ. καὶ ὀστράκινα."

²²⁵ Niceph. Blemm. 3 (*Collection*, 453): ἔστω δὲ κλοκίον τοῦτο ὑέλινον. 6: καὶ βαλεῖν αὐτὰ ἐν κλοκίῳ ὑέλινῳ. 15: εἶτα πάλιν στρέψον αὐτὸ ἐν τῷ κλοκίῳ τῷ ὑέλινῳ. See above, n. 214.

79. *Mortarium* (*Mortar*). A glass *mortarium*, 'mortar,' is mentioned in Latin.²²⁶

80. *Ammola* (*Vessel*). A good, strong glass *ammola*, "like those which come with sirup from Alexandria," is mentioned in the *Liber Sacerdotum*.²²⁷

This list does not include many of the vessels preserved in museums; it records only glass vessels mentioned in Greek and Latin literature.²²⁸

D. MEDICAL USES.

1. *Burning Glass*. In Aristophanes' *Clouds*¹ Strepsiades asks, "Now, haven't you seen at the druggists' shops that beautiful, transparent stone with which they kindle fire?" And Socrates answers, "You mean the *hyalos* (the burning glass)?" One scholiast explains this burning glass as a crystal; another says that "it is a circular apparatus of glass made for this purpose. When they have covered it with oil and exposed it to the sun, they touch a wick to it and light it."² The scholiasts have evidently mentioned the types

²²⁶ *Liber Sacerdotum*, 25 (Berthelot, *Hist.* 1, 192): in vitro mortario pone et per II dies pisa. See numbers 71 and 73.

²²⁷ 198 (*Hist.* 1, 225): si vis facere de pisce alkimiam . . . pone eam in unam bonam ammolam vitri, fortem, similem illis que veniunt cum sirupo de Alexandria.

²²⁸ In Manget, *Bibliotheca Chemica* (1702), there are a number of references to glass vessels and instruments, some of which might have been added to the list given above. However, since most of the references are of a comparatively recent date, they will be given here instead: *circulatorium*, 1, 291, 332; *alembicus*, 1, 332, 540, 765 (see also Berthelot, *Hist.* 2, 165); *cucurbita*, 1, 332; *retorta*, 1, 302, 332; *sublimatorium*, 1, 332; *patella*, 1, 332, 540, 548; *separatorium olearum*, 1, 332; *paropsis* (*parapsis*), 2, 559, 645, 659; *vesicum*, 2, 561; *ventres*, 2, 653 (see also Berthelot *Hist.* 1, 140); *distillatorium*, 2, 649, 654; *scutella*, 2, 658; *pistillum*, 2, 659; *spatula*, 2, 699; *scapha*, 3, 706; *ovum philosophicum*, 3, 706; *patera*, 3, 706, etc.

¹ See above, p. 20, n. 5.

² Dübner, *Schol. Gr. in Aristoph., Schol. in Nub.* (1855), 766: τοῖς φαρμακοπώλαις : φαρμακοπῶλαι κυρίως οἱ τὰ φάρμακα πιπράσκοντες, τὰ τε λυσιτελοῦντα καὶ τὰ θανάσιμα. παρὰ τοῖς παλαιοῖς δὲ καὶ οἱ τοὺς τιμαλφεῖς (τουτέστι πολυτίμους) λίθους πιπράσκοντες, φαρμακοπῶλαι ἐλέγοντο. οὐδεὶς γὰρ τῶν τοιούτων λίθων ὃς οὐκ ἔχει καινότεραν δύναμιν. Junt.] τὸν κρύσταλλον. R. V. *Id.* 768: τὴν ὑάλον λέγεις : κατασκεύασμά ἐστιν ὑάλου τροχοειδές, εἰς τοῦτο τεχνασθὲν, ὅπερ ἐλαίῳ χρίοντες καὶ ἡλίῳ θερμαίνοντες, προσάγουσι θρυαλλίδα καὶ ἄπτουσι. τοῦτο οὖν, φησὶν, εἰ ὑφάσαιμι διὰ τῆς ὑέλου, καὶ προσαγάγοιμι τῇ δέλτῳ τὸ πῦρ τῇ τοῦ γραμματέως, ἀφανίσαιμι τὰ γράμματα τῆς δίκης. (ὅτι δὲ ὑαλὸς θηλυκῶς, καὶ διὰ τοῦ α, διὸ τὸ χ). See above, p. 29, n. 35. and p. 99, n. 17. οἱ παλαιοὶ δὲ τὴν διαφανῆ λίθον, τὸν ἰδιωτικῶς λεγόμενον κρύον, εὐκότα δὲ ὑάλῳ. Junt.]. Cf. Rutherford, *Schol. Aristoph.* 1 (1896), 218ff., for the Codex Ravennas. Starkie, *The Clouds of Aristoph.* (1911), 768: Schol. V (ext) (ὡς διὰ τοῦ κρυστάλλου δυναμένους ἐναεῖν

of burning glasses with which they were familiar, and naively fancy that the glass in some way accumulates heat in itself from exposure to the sun. A scholiast on Hesiod³ speaks of the fire being brought down from the air. Although the burning glass might be used for many purposes, it seems significant that it was mentioned as being kept at the druggists' shops. One of the chief uses was for cauterizing wounds, and for this reason I am treating it under medical uses. Aristotle (*S.* IV)⁴ notes the fact that the sun's rays passing through glass kindle fire. Theophrastus (*S.* IV-III)⁵ says that the fire does not pass through the pores as some think. There are a few other rather doubtful passages which seem to refer to a burning glass.⁶

A second type of burning glass is a globe of water. Pliny (*S.* 1),⁷ Lactantius (*S.* 3/4),⁸ and Titus Bostrensis (*S.* 4)⁹ record that such vessels produce fire when held to the sun. Pliny¹⁰ also says that physicians consider nothing better for cauterizing than a crystalline

παρά δὲ Ὀμήρῳ καὶ τοῖς ἀρχαίοις ἡλεκτρος μὲν ἔστιν, ὕελος δ' οὐ. || ἄλλως.) κατασκευασμὰ ἔστιν ὕαλου τροχοειδές, [(ῆ) ἡλέκτρον Su.] εἰς τοῦτο τεχνασθέν, ὅπερ ἐλαίῳ χρίοντες [χρίσαντες Su.] καὶ ἡλίῳ θερμαίνοντες [θερμήναντες Su.] προσάγουσι θρυαλλίδα [-δι Ruth.] καὶ ἄπτονται τοῦτο οὖν φησιν ὅτι εἰ ὑθάψαιμι διὰ τῆς ὕελου [ῆλέκτρον Su.] καὶ προσάγοιμι [-αγάγοιμι R, Su.] τῇ [R, Su.: τῶν] δέλτῳ τὸ πῦρ τῇ τοῦ [R, Su.: τοῦ τε V] γραμματέως, ἀφανίσαιμι τὰ γράμματα τῆς δίκης [also Su. s. v. ὕελῃ]. See above, p. 31, n. 43; p. 36, n. 17.

³ *Scholias* (Flach (1876), 427, 31ff.): ἡ καὶ διὰ τινος μαχανῆς, πυρὸς ἐξ ἀέρος κατενεχθέντος, ὅποια καὶ τὰ διὰ λίθων, κρυστάλλων καὶ ὕελων ἐξαπτόμενα, καὶ τὰ πυρεῖα τοῦ μεταξὺ ἀέρος ἐκπυρῶσει ἐκφαίνουσι πῦρ.

⁴ *Analyt. Post.* 1, 31: οἷον εἰ τὴν ὕελον τετραπυμένην ἐωρῶμεν καὶ τὸ φῶς διούν, δῆλον ἂν ἦν καὶ διὰ τί καίει, τῷ ὀρᾷ μὲν χωρὶς ἐφ' ἐκάστης, νοῆσαι δ' ἅμα ὅτι ἐπὶ πασῶν οὕτως.

⁵ *De Igne*, 73: ὥστε τὸ μὲν τῷ ἀθροισμῷ καὶ τῇ λεπτότητι διαδύμενον εἰς τὸ ἔκκαυμα δύναται καίειν τὸ δ' οὐδέτερον ἔχον οὐ δύναται. ἐξάπτεται δὲ ἀπὸ τε τῆς ὕελου καὶ ἀπὸ τοῦ χαλκοῦ καὶ τοῦ ἀργύρου τρόπον τινα ἐργασθέντων, οὐχ, ὥσπερ Γοργίας φησὶ καὶ ἄλλοι δὲ τινες οἴονται, διὰ τὸ ἀπίεναί τοι τὸ πῦρ διὰ τῶν πόρων. See Diels (*Sitzungsber. d. Berl. Akad.* 1 (1884), 351ff.).

⁶ Diels, *Anon. Lond.* (1893), 39, 18: [κ(ατα)κ]αέντα ὑφ' ὕαλου καὶ εἰ. Note: "ὕαλος videtur esse speculum causticum." Alex. Aphrod. *Problem.* 1, 61: τὸ δὲ ἀπὸ ἡλίου καὶ ὕδατος πῦρ τῷ ἀνακλωμένῃς τὰς ἀκτῖνας τοῦ ἡλίου πρὸς τὴν ὕαλον, καθάπερ καὶ ἐπὶ τῶν κατόπτρων ἐκπυροῦσθαι καὶ πάλιν διαπέμπεσθαι ἐπὶ τὸ ὑπτίον.

⁷ See above, p. 159, n. 62.

⁸ *De Ira Dei*, 10: orbem vitreum plenum aquae si tenueris in sole, de lumine, quod ab aqua refulget, ignis accenditur, etiam in durissimo frigore.

⁹ *Adv. Manichaeos*, 2, 31 (*Patr. Gr.* 18, 1193C): μᾶλλον δὲ πυρὸς αὐτὸς γόνιμός ἐστιν, εἴ τις ἐν ἀγγεῖῳ ὕδωρ ὑελίνῳ ἀντικρυς αὐτῷ προσαγάγοι συναγομένη γὰρ τῷ διαγγεῖ τοῦ τε ὕδατος καὶ τῆς ὕελου τῆς ἡλιακῆς ἀκτῖνος ἢ ἀκμῇ, καὶ πρὸς στενὸν μὲν παραπεμπομένη, προσομιλοῦσα τε ὕλη, ῥαδίως πυρὸς ἀντιλαμβανομένη, ἅμα τε τίκτει πῦρ, κτλ.

¹⁰ See above, p. 79, n. 3.

ball held between the sun and the part of the body to be burned. Here the 'crystalline ball' is pretty certainly a glass object.

2. *Container*. Notice has already been taken of the very common use of glass vessels to hold medicines or their ingredients, dry or liquid; as a cupping glass; and as a suitable container for fluids which are being observed.¹¹

3. *Medicine*. One of the strangest uses for *vitrum* is as an ingredient in certain medicines. At once two questions arise: first, does *vitrum* refer to glass or woad, and, second, if to glass, could it be used in a medicine without injury? Sometimes it is clearly stated that *vitrum* is white like crystal, or it is mentioned along with diaphanous stones, or refers to a mirror or window; on the other hand, at times *vitrum* is described as an herb. Of course in such cases there is no doubt. In instances where it is not specifically stated that *vitrum* is an herb, I shall list it as glass, which is the much more common sense of the word.

The idea of eating glass was as ridiculous to the Romans as it would be to us. In *The Origin of the Roman Race* (S. 4) an Alexandrian by the name of Arpocras is called *polyfagus* and represented as eating broken glass vessels, claws, bones, and the like.¹² But when ground to a fine powder, it was considered a suitable ingredient in medicines,¹³ for trouble with the teeth,^{13a} gravel,¹⁴ ulcers,¹⁵ uri-

¹¹ See above, p. 156, n. 35^a; 158, 50; 160, 67; 161, 75-76; 164, 93; 167, 126; 169; 145; 169, 148; 170, 151-152^b; 157; 171, 162; 172, 170; 174, 194-195, 198; 175, 200.

¹² *Orig. Rom. Chron.* 146, 3: Nero imp ann. XIII menses V dies XXVIII . . . hoc imp. fuit polyfagus natione Alexandrinus nomine Arpocras, qui manducavit pauca: aprum coctum, gallinam vivam cum suas sibi pinnae, ova, pineas, clavos galligares, vitrea fracta, thallos de scopa palmea, mappas IIII, porcellum lactantem, manipulum feni, et adhuc esuriens esse videbatur. This man is mentioned also in Suet. *Nero*, 37, 2, but without any statement concerning his special accomplishments.

¹³ Orib. *Synop.* 2, 46, *Prop. Med. Simpl.* (Bussemaker-Daremborg, 5 (1873), 61, 1): ὕελος.

^{13a} Scrib. Larg. *Comp.* 60: ad dentium colorem et confirmationem bene facit radices edulis cortex sole arefacta et contusa, cribata; item vitrum candidum quod simile crystallo est, diligenter tritum admixta spica. Marcell. *de Med.* 13, 3: vitrum candidum, quod simile est crystallo, diligenter tritum admixta spica nardi pro dentifricio adhibitum plurimum prodest. Evidently a sort of tooth-powder is meant.

¹⁴ Galen, *de Affectuum Renibus Insidentium Diagn.* 8, 19, 695: ὕελος κεκαυμένη καὶ ὁ Καππαδοκικὸς λίθος καὶ τὸ τῶν παλιούρων σπέρμα καὶ ταῦτα κατὰ κράτος διαιροῦσιν. Orib. *Collect. Med.* 15, 1, 25, 14ff. (Bussemaker-Daremborg, 2 (1854), 711ff.): καὶ ὁ ὀφίτης δὲ καλούμενος λίθος ῥιπτικῆς τε καὶ θρυπτικῆς ἐστὶ δυνάμει, ὥσπερ καὶ ἡ ὕαλος· ἱκανῶς γὰρ καὶ αὕτη θρύπτει πινομένη διὰ οἶνου λευκοῦ καὶ λεπτοῦ τοὺς ἐν κύστει λίθους. Paul. Aeg. 7, 3: ὕαλος. λεία πινομένη μετ' οἶνου λεπτοῦ καὶ λευκοῦ τοὺς ἐν κύστει λίθους θρύπτειν λέγεται. Adams, *ad loc.*: "Our author borrows his paragraph on this subject from Aëtius (II, 31)." Alex. Tralles in Rufus, 412, 95, 21, 94: νεφριτικὸν ξήριον πρὸς δυσουρίαν καὶ λιθίαν. 95: ἄλλο ᾧ καὶ αὐτὸς κέχρηται.

nation,¹⁶ dysentery,¹⁷ in emetics,¹⁸ and in plasters.¹⁹ The medical use of glass is treated of extensively by the Arabians.^{19a} Benvenuto Cellini²⁰ established the fact that glass is not really harmful. He asserts that the diamond is the only injurious stone, because it is so hard and sharp that it will cut into the organs, but when other stones are pounded they become blunt; hence, glass and other stones when mixed with food pass along with it. Although we realize that glass is not so injurious as has often been thought, still it is difficult to understand what beneficial effect it could possibly have had.

ἀγαρικοῦ Γο α', ἀλθαίας σπέρμα Γο σ', λινოსπέρμον Γο σ', κνίδης σπέρμα καρπο-
βαλσάμον, παλιούρον σπέρμα, ὕελον, ἀνὰ γρ. σ'. δίδου ἐκ τοῦ ξηρίου γρ. α'. μετὰ
χρυσαιτικοῦ ζέματος ἢ ἡρυγγίου καὶ ἀγρώστεως, καὶ σικίου σπέρματος, καὶ ἀτρακ-
τυλίδος βοτάνης.

¹⁵ Galen, 13, 663: τὸ διαφανὲς καὶ ὕαλος κεκαυμένη.

¹⁶ *Id.* 10, 749: ὕαλος ἢ κεκαυμένη.

¹⁷ Marcell. *de Med.* 27, 41: vitrum teres diligenter et criblabis et masticis grana teres atque aequis mensuris permiscebis et ex his singula coclearia dysinterico in vino cocto per triduum vel quotiens opus fuerit dabis, miraberis remedium experimentis probatum. Pseudo-Theodorus, *Add.* 2, 31, *de Dysentericis*, 331, 16: vel si pulverem de speculare vitreo facias, et ibi intinctum iecur manducet.

¹⁸ Claud. Herm. *Mulomed. Chiron.* 11: vitrium tusum ferragini aspergis, ut possit spurcitas corporis per solutionem ventris expurgari.

¹⁹ Marcell. *de Med.* 26, 131: vitrum teres diligenter et cum pice cedria miscebis atque ita chartam virginem inlines et renibus adpones, quo medicamine diebus septem iugiter usus sanus firmiter eris. Demetrius, *Hier.* 271: τράκτωμα εἰς κλάσμα ποδὸς ἱέρακος ὕελος Ἀλεξανδρινήν, σμύρναν ἀληθινήν, πίσσαν καὶ λίβανον λειοτριβήσας καὶ ἅμα ψοῦ τὸ λευκὸν ἀναλαβὼν ἐπίθης, καὶ σφίγγας μετὰ ἐρίου ἀπόλυσον αὐτὸν εἰς οἴκημα. 275: μαρμάρου μέρος ἓν, ὀστράκου μέρος ἓν, ὑελίου μέρος ἓν, λύχνου μέρος ἓν, μαστίχης, πεπέρως, ῥήτινης, κλήμα σταφυλῆς μελαίνης καυθὲν καὶ ξηρὸν γενόμενον μέρος ἓν, ταῦτα πάντα κόψας καὶ σήσας ἀναλάμβανε, καὶ κόπρον ὄρνιθος καὶ ὄξους τὰ ἀρκοῦντα, καὶ ἐπιδέσκει ὡς προείρηται. 281: εἴτα λίβανον καὶ λιθάργυρον καὶ ὕελον Ἀλεξανδρινήν καὶ ψοῦ τὸ λευκὸν καὶ κοχλίου τὸ κολλῶδες καὶ σιελῶδες λειώσας . . . λαβὼν φλεβότομον ἢ μάχαιραν ἡκονημένην ὀξεῖαν κέντησον αὐτὸν ἐπάνω τοῦ οἰδήματος, καὶ τρίψας λίβανον καὶ λιθάργυρον καὶ ὕελον Ἀλεξανδρινήν καὶ ψοῦ τὸ λευκὸν καὶ τὰς τῶν κοχλίων σάρκας. 283: λαβὼν λίβανον ἀρρενικὸν καὶ ὕελον καὶ μάρμαρον, τὸ ἴσον ἐκάστων τρίψας καὶ λειώσας ἀναλάμβανε χολὴν τράγου καὶ ψοῦ τὸ λευκὸν, καὶ ἐπίθης εἰς τὸν ὀστράγαλον τοῦ ἱέρακος καὶ ἐπιδέσκει εὐφύως.

^{19a} Adams, *The Seven Books of Paulus Aegineta*, 3 (1847), 384 f.: "See Avicenna (2, 2, 720); Serapion (*De Simpl.* 382); Phases (*Cont.* 1. ult. 1, 748); Ebn Baithar (1, 723); Haly Abbas (*Pract.* 2, 47.) (?) As to its medical properties, he [Serapion] says . . . that it removes furfures of the head, and is applied to the head and beard as a depilatory. When pounded and drunk with wine, it is lithontriptic. One of his Arabian authorities, Aben Mesuai, says glass is good for the lungs and for baldness. Avicenna further recommends it as a dentifrice, and as an application to remove albugo of the eye, in which case, he adds, the bwint is most efficacious. . . . We may mention in conclusion that although glass has long been excluded from the practice of the regular physician, we have often heard of powdered glass having been used by empirics, and certainly in some cases with good effect, to remove opacities of the cornea. See also Gray (*Suppl. to Pharmacop.* 260.)"

²⁰ *Memoirs*, 1, 125.

4. *Absorbent*. Paulus Aegineta (*S.* 7)²¹ mentions 'foamy glass', which must have been an absorbent of some kind, as Liddell and Scott, *s. v.*, observe. Probably it was used somewhat as fine white sand used to be employed in many countries, and no doubt still is employed in some places, to take up excess ink, instead of blotting paper.^{21a}

5. *Aids to Eyesight*. An old scribe in the Anthology²² is represented as dedicating his tools, among which is an object which Paton²³ translates as "his blue spectacles that give sweet light." If this is what the author meant, the 'spectacles' were probably not lenses to correct or improve the sight, although magnifying lenses were known at a very early date^{23a}, nor a whetstone (Liddell and Scott), scarcely even an ordinary eyeshade, because of the plinth-like shape, but very probably a large, flat, rectangular piece of transparent glass with a bluish tint, which gave relief to his eyes. The emerald in which Nero is reported to have watched the gladiatorial combats²⁴ has been definitely shown to be nothing but a large piece of green transparent glass, used as amber tinted glass is so commonly employed nowadays, to rest and relieve the eyes.²⁵

The Greeks and Romans realized that a glass globe filled with water had the power to magnify,²⁶ but there is no literary evidence

²¹ 6, 22: ἡ φλεβοτόμω τὸ μεταξὺ τοῦ κανθοῦ σῶμα πρὸς τὸ ἀπόσχημα ἀπολύσαντες. σάρκας ἐκ τοῦ βάθους ἀναγάγωμεν, καὶ τότε μετρίως ὑποξηράνωμεν. ὕαλος δὲ χροώδης ἐπιπαπτομένη τούτοις θαυμασίως ξηραίνει. Adams translates: "Glass reduced to a fine powder is wonderfully desiccative."

^{21a} The sanding box, somewhat resembling a large salt shaker, is to be found in some American Museums. Recently Professor Knapp (*The Class. Weekly*, 19 (1926), 158) mentioned the use of sand as a blotter in America and Italy, and raised the question of whether sand may not have been employed for this purpose by the Romans. Although no one has noted such a use recorded in Latin literature, other contributors are familiar with the use of sand as a blotter in India (Shewan, 19, 230; Wedeck, 20, 8), Greece (Brouzas, 20, 74), the Orient (Wedeck, *loc. cit.*), and Switzerland (Fox, Price, 20, 129). To this list Germany (i.e. Munich) might be added (Oldfather), and no doubt many other countries, for this use of sand seems to have been quite general.

²² Phantias, *Anth. Pal.* 6, 295: καὶ τὰν ἀδυσφᾶ πλινθίδα καλλαῖναν.

²³ Loeb Library translation.

^{23a} Cuming (*The Jour. of the Brit. Archaeol. Assoc.* 11 (1855), 144-150) thought the ancients probably had spectacles. Lessing, *Briefe antiq. Inhalts.* (1769), 106ff.; Kisa, *op. cit.* 2, 357; Beck, *Ancient Magnifying Glasses (The Antiqu. Journ.* 8 (1928), 328 ff.

²⁴ Plin. *N. H.* 37, 64: Nero princeps gladiatorum pugnas spectabat in smaragdo.

²⁵ Kisa, *op. cit.* 2, 356; Netoliczka (*P.-W.* 11, 30); Greef (*Wiener Blätter*, 2 (1924), 121-3).

²⁶ See above, p. 155, n. 30-31. Strabo, 3, 1, 5: διὰ δὲ τούτων ὡς δι' αὐλῶν κλω-

that they used glass lenses for the purpose of magnifying, although of course they mention a coarse kind of lens in the shape of a burning glass. (See above, D 1). At a very early time the lens for magnifying no doubt grew out of observations made on glass globes of water and burning glasses.

E. PLAYTHINGS

1. *Pawns*. The Romans had a game, *ludus latrunculorum*, which somewhat resembled modern checkers or draughts. The pawns, which seem frequently to have been made of glass, were called *miles*, 'soldier,' *hostis*, 'enemy,' and *latro*, 'mercenary' or 'robber.' The *latro* was only another name for the *hostis* as must be clear from the passage quoted in the long note below. That is, the *hostis* goes into other territory to plunder (as *latro*) and then gets into trouble. Of course each player's men were *latrones* to the other side. It must have been a kind of "catch the robbers" game, like "fox and geese," only on a board. In a long description of the game given by the author of the *Laus Pisonis* (S. I)¹ we find that black and white pawns were used; "wars are waged by a glass soldiery so that now the white checks the black, now the black checks the white." Martial (S. I)² refers to the same game, mentioning the use of a glass *latro*. Possibly also the jewel pawns mentioned by him were in reality of glass.³ Ovid (S. I)⁴ says that the way to

μένην τὴν ὄψιν. Müller-Dübner (1853) suggest "vitris" in the Latin translation, following Is. Voss's convincing emendation: δι' ὕλων. Jones in the Loeb Library translates (1923): "that is, the visual rays, in passing through this vapour as through a lens, are broken and therefore the visual impression is magnified," and adds in note 1: "A globe filled with water, apparently."

¹ 19off.: te si forte iuvat studiorum pondere fessum | non languere tamen lususque
 movere per artem, | callidior modo tabula variatur aperta | calculus et vitreo
 peraguntur milite bella, | ut niveus nigros, nunc et niger alliget albos. | sed tibi
 quis non terga dedit? quis te duce cessit | calculus? aut quis non periturus perdidit
 hostem? | mille modis acies tua dimicat: ille petentem | dum fugit ipse rapit;
 longo venit ille recessu, | qui stetit in speculis; hic se committere rixae | audet et in
 praedam venientem decipit hostem; | ancipites subit ille moras similisque ligato |
 obligat ipse duos; hic ad maiora movetur, ut citus effracta prorumpat in agmina
 mandra | clausaque deiecto populetur moenia vallo. | interea sectis quamvis
 acerrima surgant | proelia militibus, plena tamen ipse phalange | aut etiam paucos
 spoliata milite vincis, | et tibi captiva resonat manus atraque turba. See Martin,
Laus Pisonis (1917), 81ff.

² 7, 72, 8 (7): sic vincas Noviumque Publiumque | mandris et vitreo latrone
 clusos.

³ See above, p. 109, n. 17. Cf. p. 82, n. 21.

⁴ *Amat.* 2, 208 (207): sive latrocinii sub imagine calculus ibit, fac pereat vitreo
 miles ab hoste tuus!

gain favor is to "let your soldiers be taken by a glass enemy," when playing this *ludus latrunculorum*. Although the fact is not mentioned in literature, gaming boards also were inlaid with glass.^{4a}

2. *A Ball*. An inscription (*S.* 2),⁵ written evidently by a cheerful old man whose success at playing ball is waning, begins: "If you still believe me, I am Ursus, the first citizen to play properly with a glass ball with my players, in the baths of Trajan, of Agrippa and Titus, and often in the bath of Nero, with the tumultuous approval of the crowd." It is impossible at this time to go into the question of what type of a game Ursus played with his glass ball, but obviously it could not have been one in which the ball was bounced or batted.

F. MIRRORS

It is a matter of common knowledge that ancient mirrors were usually of polished metal.¹ Just how early glass was used for them is not known, although its power of reflection was observed at an early time. Theophrastus (*S.* IV/III)^{1a} speaks of certain glass-like gems which reflected images. Pliny (*S.* 1) mentions the emerald² and carbuncle³ as suitable for mirrors. Natural stones which resembled glass, as obsidian⁴ and phengite,⁵ were used to line walls,

^{4a} See above, p. 14ff, n. 32. 32a.

⁵ CIL 6, 9797, 1; Bücheler, *Carm. Lat. Epigr.* 1 (1895), 29, 1; Dessau, 2, 1, 5173: Ursus, togatus vitrea qui primus pila | lusi decenter cum meis lusoribus, | laudante populo maximis clamoribus, | thermis Traiani (*sic*) thermis Agrippae et Titi, | multum et Neronis, si tamen mihi creditis, | ego sum. ovantes convenite pilicrepi | statumque amici floribus violis rosis | folioque multo adque unguento marcido | onerate amantes et merum profundite | nigrum Falernum aut Setinum aut Caecubum, | vivo ac volenti de apotheca dominica, | Ursumque canite voce concordi senem | hilarem, iocosum, pilicrepi, scholasticum, | qui vicit omnes antecessores suos | sensu decore adque arte suptilissima. | nunc vera versu verba dicamus senes: | sum victus, ipse fateor, a ter consule, | vero patrono, nec semel, sed saepius, | cuius libenter dicor exodiarius.

¹ Cf. *Job*, 37, 18: "Firm as a molten mirror." Dr. S. E. Bassett's interpretation of I *Cor.* 13, 12, 'Through a glass darkly,' in which he understands by δι' ἐσόπτρου, 'by means of a mirror,' will appear in the *Journal of Biblical Literature* during the present year.

^{1a} See above, p. 49, n. 56.

² *N. H.* 37, 64: quorum vero corpus extantum est eadem qua specula ratione supini rerum imagines reddunt.

³ *Id.* 37, 97: illos nigriores e quibus et specula fieri.

⁴ See above, p. 145, n. 14.

⁵ Suet. *Domit.* 14: parietes phengite lapide distinxit, e cuius splendore per imagines quidquid a tergo fieret provideret. On the discovery of this stone: Plin. *N. H.* 36, 163: in Cappadocia repertus est lapis candidus, atque translucens, ex argumento phengites appellatus. Cf. Strab. 12, 2, 10: ἄλλως δὲ εἰς διόπτρας βάλους μεγάλας ἐκδίδους, ὥστε καὶ ἔξω κομίζεσθαι.

not only for decoration, but so that one could see what was going on behind one's back. It has been suggested that the *kataptron*, 'mirror,' in the temple to reflect the image of the god, mentioned by Pausanias (*S.* 2),⁶ was of glass or a glass paste,⁷ but I know of no very convincing reason for so believing. It is usually impossible to tell from the context whether a *kataptron* or *speculum* is of glass or some other material.⁸ The first glass mirrors were probably pieces of dark glass⁹ which reflected the image in the same manner as the natural stones which were used for wall covering.

Pliny ascribes to the Sidonians the invention of the glass mirror,¹⁰ although the sense of this passage has been somewhat disputed.¹¹ The first description of a genuine glass mirror, i. e., with a metal back, occurs in the *Problemata*^{11a} of Alexander of Aphrodisias (*ca.* 220 A.D.).¹² The backing was of tin here as well as in the case of the mirror mentioned by Philoponus (*ca.* 550 A.D.).^{12a} Olympiodorus,¹³ a contemporary of Philoponus, also mentions a glass

⁶ 8, 37, 7: ἐν δεξιᾷ δὲ ἐξιώντι ἐκ τοῦ ναοῦ κάτοπτρον ἡρμοσμένον ἐστὶν ἐν τῷ τοίχῳ· τοῦτο ἦν τις προσβλέπη τὸ κάτοπτρον, ἑαυτὸν μὲν ἥτοι παντάπασιν ἀμυδρῶς ἢ οὐδὲ ὄψεται [τὴν] ἀρχήν, τὰ δὲ ἀγάλματα τῶν θεῶν καὶ αὐτὰ καὶ τὸν θρόνον ἔστιν ἐναργῶς θεάσασθαι.

⁷ Netoliczka (*P.-W.* 11, 30); Nowotny (*Jahresheft d. Öst. Arch. Inst.* 13 (1910), 107).

⁸ Kisa, *op. cit.* 2, 358.

⁹ Chalcid. on Plat. *Tim.* 242: quae autem paraphasis ab his adpellatur, provenit quotiens non in cute speculi, sed introrsum et tamquam in penetralibus simulacrum invenitur obumbrante aliqua nigredine, ut in perlucidi quidem sed fuscī vitri lamina vel stagnis atris ex alto profundo.

¹⁰ See above, p. 102, n. 3.

¹¹ Nesbitt, *op. cit.* 45; Nowotny, *op. cit.* 13, 107.

^{11a} See above, p. 38, n. 36.

¹² Marquardt, *op. cit.* 737, n. 2; Netoliczka, *op. cit.* 11, 30; Nowotny, *op. cit.* 13, 107, while accepting Alexander of Aphrodisias as the author of the *Problemata*, remark that there are others who ascribe the work to Alexander of Tralles (*ca.* 570). However, they do not mention the critics who hold to the later date, nor do they give their reason for so doing. H. S. Jones, also, in the first fascicle of the new edition of Liddell & Scott (1925), accepts the work as genuine, although Christ-Schmid 2, ed. 6, 834 following Zeller, 3, 1, ed. 4, 820, n. 2, regard it as spurious. Under the circumstances, therefore, I do not feel that there is sufficient ground for changing the customary ascription.

^{12a} On *de Anima*, 2, 7 (Hayduck (1897), 320, 30): καὶ τῶν ὑελίνων γοῦν κάτοπτρον τὴν ἐξωθεν ἐπιφάνειαν καττιτέρον χρώμα δοκοῦμεν ἔχειν.

¹³ On Plat. *Alcib.* 2, 223: διὰ μὲν τῶν κατόπτρων ἐδήλωσε τὰ τεχνητὰ κάτοπτρα· διὰ δὲ τοῦ καὶ τὰ τοιαῦτα τὰ φυσικά, οἷον ὑαλοκέρας. See Creuzer (1821), note 53. Ruhnken, Schol. in Plat. *Alcib.* (1800), 132E: κάτοπτρα] τὰ φυσικά, οἷον ὑαλον ἢ κέρας.

katoptron. Claudianus (*S.* 4/5) implies a glass mirror by the use of a transferred epithet.^{13a} Pseudo-Theodorus (*S.* 6)¹⁴ seems to refer to a glass mirror, and Isidore (*S.* 6/7)¹⁵ says that "there is no material better for mirrors." In the Greek lexicæ a *speklon*, 'mirror,' is defined as an *hyelion*¹⁶ or 'glass';¹⁷ *hyelion* in turn is defined both as glass and as a glass object.¹⁸ *Hyelion* was sometimes used to designate a mirror,¹⁹ but that was by no means its only use.

From these scattered references and from the finds in excavations²⁰ it is evident that glass in no sense usurped the place of metal for mirrors in antiquity. In the twelfth century Benjamin of Tudela^{20a} writes, "Here is also erected a high tower, called light-house, in Arabic Minar of Alexandria, on the summit of which was placed a glass mirror." Dillon suggests that it was not until the thirteenth century that glass mirrors of any size became general, and states, on the authority of Vincent of Beauvais, that the best ones were made of glass and lead,²¹ a combination which was used at a much earlier time, as shown by the mirrors themselves. In the fifteenth century Agrippa vaguely refers to ancient writers on the looking glass.²²

G. WINDOWS

We have already noted that the next great step after the discovery of blowing glass was the production of flat sheets of glass,¹ which were then used in windows. Of course the first glass window-panes were small and contained many imperfections, but they marked the beginning of a factor which has brought about great changes in architecture.²

^{13a} See above, p. n. 73, n. 35.

¹⁴ See above, p. 181, n. 17.

¹⁵ *Orig.* 16, 3: neque est alia speculis aptior materia.

¹⁶ See above, p. 46, n. 39.

¹⁷ Zonar. *Lex.* 1665: σπέκλον. ἡ ὑαλος (ὑέλλος A).

¹⁸ See above, p. 45, n. 36.

¹⁹ See DuCange above, p. 46, n. 39.

²⁰ Wallace-Dunlop, *op. cit.* 214ff.; *Jahrb. des Vereins v. Alterthumsfreunden*, 85 (1888), 156; G. F. Wright-F. B. Wright (*Records of the Past*, 6, 270); Nowotny *op. cit.* 13, 107ff.; Beaulieux (*Rev. de Philol.* 36 (1912), 133); Richter, *Gr. Etrusc. and Rom. Bronzes (Cat. Metrop. Mus. N. Y. (1915), 287);* Netoliczka (*P.-W.* 11, 44ff).

^{20a} Asher's translation, 1 (1840), 155.

²¹ *Op. cit.* 138.

²² *De Vanitate Scient.* ch. 26.

¹ On the making, see Theophilus, 2, 9; Cennino Cennini (*S.* 14), 171.

² Nissen, *Pompeianische Stud. z. Städtekunde des Altertums* (1877), 595ff.; Danforth (*The Scientific Monthly*, 8 (1919), 537ff).

Before and several centuries after the introduction of glass in windows, almost any transparent substance was used. In Philo (*S.* 1) we hear of windows set with diaphanous stones like white glass.³ In a number of Latin authors *specularia* are mentioned, but it is impossible to tell whether these are of glass or some other transparent material, and Salmasius⁴ notes that the same difficulty exists in the case of the Greek *hyelion* and the Latin *vitrium*. There are some who believe the invention of the *speculum* mentioned by Pliny to refer to windows rather than to mirrors,⁵ but this seems very unlikely. Pliny^{5a} says that "in Arabia also there is a stone translucent like glass, which they use for windows. Juba is the originator." We know from finds which have been made,⁶ especially at Pompeii, that glass was used in windows during the first century, although to a limited degree. Even by the fourth century glass had not become the only material for making windows; Lactantius⁷ mentions glass and *specularis lapis* side by side, when he says that the mind sees through the eye "as through windows of transparent

³ *Leg. ad Gaium*, 45: καὶ περιελθὼν προστάττει τὰς ἐν κύκλῳ θυρίδας ἀναληφθῆναι τοῖς ὑάλῳ λευκῇ παραπλησίως διαφανέσι λίθοις, οἱ τὸ μὲν φῶς οὐκ ἐμποδίζουσι, ἄνεμον δὲ εἴργουσι καὶ τὸν ἀφ' ἡλίου φλογμὸν.

⁴ *Plin. Exercit.* 77obE ff.: "... fenestras vitro decoratas vitria recens Latinitas vocavit, nosque hodie sic vocamus. Graeci ὑέλια immo ita etiam appellarunt, etiamsi ex speculari lapide essent, non ex vitro. Neophytus monachus in Lexico Herbario: Σπέκλον τὸ τοῦ φεγγίτου ὑέλιον, hoc est vitreum ex speculari lapide. quod fenestris obducebatur ad translucendum, ac lucem admittendam, specular veteres Latini vocarunt. idque ex speculari lapide qui est φεγγίτης, aut ex vitro fiebat, aut alia translucida materia . . . haec specularia porro fenestris indita ad perspiciendum Graeci ὑέλια vocarunt, quae ex vitro fierent, Latini vitria. in Symposiano aenigmate in vetustissimo nostro libro lemma inscriptum est vitrium quod de speculari intelligendum. perspicior penitus, nec luminis arceo visus. in aliis scribitur pro lemmate, specular. in aliis utrumque adpositum vitrium specular. idem specular. idem quippe vitrium, quod specular . . . Neophytus ὑέλιον etiam vocat specular, quod ex phengite lapide, non ex vitro compositum est . . . at fenestris specularia indebant e vitro vel ex alia translucida materia ad illuminandam domum . . . vitrearum fenestrarum nuntio apud Hieronymum quae vitro in tenues laminas fuso obductae erant. Paulus Silentiarius de fenestris templi Sanctae Sophiae: δοχῆϊα φωτὸς ἀνοίγει λεπταλέαις ὑέλοις κεκαλυμμένα sunt proprie quae ὑέλια dicuntur uno verbo Graecis, specularia nempe ex vitro."

⁵ See above, p. 185, n. 10.

^{5a} See above, p. 65, n. 14.

⁶ Nossio (*L'Intermédiaire des Curieux et Chercheurs*, 2 (1865), 38); Clauer, *Id.* 182; A. F. *Id.* 433; XX. *Id.* 494; Wallace-Dunlop, *op. cit.* 162ff.; Becker, *op. cit.* 2, 316, 380ff.; 3, 118; Marquardt, *op. cit.* 757; Lehner (*Jahrb. d. Arch. Inst.* 10 (1896), 43); Kisa, *op. cit.* 203, 362ff.; Blümner (*P.-W.* 7, 1389).

⁷ *De Opific. Dei*, 8: transpiciat, quasi per fenestras perlucida vitro, aut speculari lapide obductas.

glass or mica." In a work of doubtful authenticity ascribed to Athanasius⁸ note is taken of the way the sun's rays penetrate a window without doing injury to the glass. Symphosius'⁹ enigma on *vitreum* seems to be a description of a window. The first two lines might refer to any object of glass, but the last, "wintry weather does not penetrate me, but the sun does enter me," seems to indicate a window. Some explain the passage in Prudentius (*S.* 4/5) which has been treated under mosaic wall decoration,¹⁰ as referring to a window.¹¹ Sidonius (*S.* 5)¹² refers to the window as well as the wall decoration. Philoponus (*S.* 6)¹³ uses the example of a window of black glass in making an analogy; however, not with the implication that black glass was used for windows, but rather that it was a preposterous idea. Venantius Fortunatus (*S.* 6)¹⁴ speaks of the sun's rays as being captured by the glass windows. Paul the Silentiary (*S.* 6) in his poem on Sancta Sophia says, "Thus rises on high the deep-bosomed vault, borne above triple voids below; and through fivefold openings, pierced in its back, filled with thin plates of glass comes the morning light scattering sparkling rays."^{14a} An anonymous writer also mentions the windows of Sancta Sophia.^{14b} Gregory of Tours (*S.* 6) speaks of glass windows a number of times, sometimes simply as *vitreae*.¹⁵ At this period church treasures must have been extremely attractive to thieves.

⁸ *Patr. Gr.* 28, 789Bff.: ὡς περ οἶκος περιπεφραγμένος πάντοθεν ἀνατολικὸν ἔχων ὑέλινόν τε καθαρὸν καὶ λεπτότατον παραθυρίδιον, ἀνατείλαντος τοῦ ἡλίου αἱ ἀκτῖνες αὐτοῦ διαπερῶσι τὸν ὑέλόν καὶ εἰσέρχονται πάντα τὸν οἶκον καταφωτίζοντες· καὶ πάλιν παρέρχοντο τοῦ ἡλίου καὶ τῶν αὐτοῦ ἀκτῖνων ἐξερχομένων, ὁ ὑέλός οὐ συντρίβεται, ἀλλ' ἀβλαβής ἐκ τῶν εἰσερχομένων τε καὶ ἐξερχομένων προσκρούσων τοῦ ἡλίου διαμένει ἀκτῖνων· διὰ τοῦ ὑελίνου παραθυρίδιου, κτλ.

⁹ See above, p. 78, n. 63.

¹⁰ See above, p. 141.

¹¹ See above, p. 141, n. 25.

¹² See above, p. 141, n. 27.

¹³ *On de Anima.* 2, 7: καὶ ὡς περ εἴ τις οἶκος εἴη μίαν μόνην ὀπήν ἔχων, εἴη δ' ἐν ἐκείνῃ τῇ ὀπῇ ὑέλός κατακόρως μέλαινα.

¹⁴ *Carm.* 2, 10, 13: de ecclesia Parisiaca. prima capit radios vitreis oculata fenestris | artificisque manu clausit in arce diem.

^{14a} 409 (*Corp. Script. Hist. Byz.* 36 (1837), 21): ὡς ἡ μὲν βαθύκολπος ἀνέσσονται ἡέρι κόγχῃ, | ὑψόθεν ἀντέλλουσα μία, τρισσοῖσι δὲ κόλποις | νέρθεν ἐπεμβεβαῦια, διατμηγείσα δὲ νῶτοις | πένταχα μοιρηθέντα δοχῆϊα φωτὸς ἀνοίγει, | λεπταλέαις ὑάλοις κεκαλυμμένα, τῶν διὰ μέσης | παιδρὸν ἀπαστράπτουσα φασφόρος ἔρχεται ἡώς. Translation by Lethaby-Swainson, *The Church of Sancta Sophia Constantinople* (1894), 40. See also, p. 169, 289f.

^{14b} See above, p. 46 n. 40.

¹⁵ See above, p. 78, n. 64.

Gregory tells of robbers who entered by breaking the windows.¹⁶ Once the windows themselves were stolen; the thief melting down and selling the glass. But according to the story he was afflicted with leprosy because of his crime.¹⁷ This incident is interesting in that it shows the difficulty the ancients had in fusing new glass, so that they were willing to melt up old glass. Nelson¹⁸ speaks of the windows of the church of Saint Martin of Tours as the first colored glass windows mentioned in literature with which he is familiar. In 675 Benedict, bishop of Wearmouth, sent to Gaul for glass-makers to decorate the windows of his church, the cloisters and dining rooms.^{18a} Anastasius¹⁹ in the *Life of Leo III* (S. 8) speaks of church windows of variously colored glass. It was a long step from the first glass windows in the Roman houses and early churches to the elaborately pictured church windows described by Theophilus.²⁰

Although we know that glass was gradually winning its place in the house as well as in the cathedral, most of the references have been to church windows. It is rather interesting to find also an indication

¹⁶ *De Mir. S. Jul.* 13: cumque intrare non possent, unus effractam ceu fur in altario sancto fenestram vitream, ingreditur, quia qui non intrat per ianuam hic latro est. *Hist. Franc.* 6, 10: his diebus basilica Sancti Martini a furibus effracta fuit, qui ponentes ad fenestram obsidae cancellum, qui super tumulum cuiusdam defuncti erat, ascendentes per eum, effracta vitrea sunt ingressi.

¹⁷ *De Glor. Martyrum*, 59: ecclesia est vici Icidioresis, sub termino Turonicae urbis, quae plerumque sacris miraculis illustratur, fenestras ex more habens quae vitro lignis incluso clauduntur, quo praeclarius aedi sacratae lumen quod mundus meruerit subministrant. quam ecclesiam fur nocturnus importunusque aggreditur, ingressusque nocte, cum omnia cerneret custodem cura tueri, et nihil de sacris ministeriis quod auferret adverteret, ait intra se: si aliud, inquit, invenire non possum, vel has ipsas quas cerno vitreas auferam, fusoque metallo aliquid auri conquiram mihi. ablatis igitur dissipatisque vitreis, metallum abstulit, et in pagum Biturigi territorii contulit. missumque vitrum in fornace per triduum decoquens, nullum exinde opus potuit expedire: victusque crimine, divinum super se iudicium intuens, nequaquam motus perdurat in malis. ablatum autem a cacabo vitrum, quod in pilulis nescio quibus conversum fuerat, advenientibus negotiatoribus venumdedit, ut scilicet accepta pecunia, novus Giezi, lepram perpetuam compararet. nam adveniente die post anni curriculum, quod hoc furtum fecerat, caput eius tumori datur: oculi quoque inflantur, ut erui a suis locis autumentur. haec autem ei singulis annis eveniunt in die illa qua furtum admisit. plangitque miser vitrum, quod ex itinere quo transmisit non potuit revocare.

¹⁸ *Loc. cit.*

^{18a} See above, p. 113, n. 7b.

¹⁹ *Leo III*, 408 (*Patr. Lat.* 128, 1235): praefectus vero pontifex fecit in basilica Domini nostri Jesu Christi, quae appellatur Constantiniana, supra altare maius vestes chrysoclavas duas . . . simul et fenestras de absida ex vitro diversis coloribus conclusit atque decoravit. et alias fenestras basilicae ex metallo Cyprino reparavit.

²⁰ 2, 17ff.

of a less pretentious use, namely in the bird house. Demetrius (*S.* 13)²¹ says that it is not a good thing to use glass windows in a falconry because the birds are likely to break them by flying against them and be killed by the broken pieces.

H. LAMPS

1. *Candela, Lucerna, Lychnus, Lampas (Lamp)*. The first reference I find to glass lamps is in the fourth century where many large *candelae*, 'oil lamps,' are described as hanging in a church.¹ This use of *candela*, which usually means candle, is rather late,² but it is found in Greek³ as well as Latin.

Prudentius⁴ also mentions a hanging lamp suspended from the panelled ceiling. Paulinus Nolanus (*S.* 5)⁵ describes one of tree-like appearance which "bore little glass *calicli* (cups) as if they were its fruit." Elsewhere he speaks of the handles of glass *lucernae* being inserted in a hanging lamp.⁶ Venantius Fortunatus (*S.* 6)⁷ mentions

²¹ *Hier.* 26: μετὰ δὲ ταῦτα οἰκίσκον ἐκλεξάμενος καλὸν λίαν καὶ εὐρύχωρον (εἰ δὲ μὴ οἶόν τε, κὰν σύμμετρον) κατακλείει ἐν αὐτῷ τὸν ἱεράκα ἔχοντα πρὸς ἀνατολὴν ἡλίον θύραν ῥάβδοις οὐχ ὑέλῳ διαπεφραγμένην, ἵνα καὶ φῶς ἔχῃ αὐτάρκως καὶ διαφυλάττηται ἀσφαλῶς· τὴν γὰρ ὑέλων ῥήγνυνσι παραντίκα περιπτάμενος καὶ παίων καὶ προσρηγνύμενος αὐτῇ, ὥσπερ κατάδικος ἄρτι τῶν δεσμῶν ἀφεθείς. τοῦτο δὲ ποιήσας ἄπεισιν, ἢ τοῖς τῆς ὑέλου θρύμμασιν ἐμπεσὼν καὶ ὥσπερ ὑπὸ ξίφους τρωθεὶς δαιφθεί-
ρεται . . . εἶτα εὐρέτω οἰκίαν καλὴν καὶ εἰς εὖρος ἐπιτήδειαν, ἔχουσιν καὶ θύραν κατὰ ἀνατολὰς μετὰ δρυφράκτων πυκνῶν καὶ οὐχὶ μετὰ ὑέλων, τοῦ τε φῶς ἔχειν ἔνεκεν καὶ τοῦ μὴ δύνασθαι φεύγειν ῥαδίως· τοὺς γὰρ ὑέλους θραύσειεν ἄν, καὶ ἢ βλαφθῆσεται κατὰ τι μέλος ἢ φευγέϊται.

¹ *S. Silviae Perigrinatio*, 57: *candelae autem vitreae ingentes ubique plurimae pendent, et cereofala plurima sunt, tam ante anastasim, quam etiam ante crucem, sed et post crucem.*

² DuCange, *Gloss. Med. et Inf. Lat. s. v. candela*, quotes another example to show its use at night: "Testam. ann. 1250. tom. 2. Hist. Cassin. p. 494. col. 1: in primis de oleo *candelae vitreae* emantur, et horis competentibus illuminentur et repleantur.

³ *Suid. s. v. οὐρίαχος*: . . . "ὄφρα κεν ἐξ ὑάλιοι πυρικμήτοιο ταθέντας οὐρίαχους δέξαιτο," τὰ οὐραία τῶν κανδηλῶν. See below, n. 8. Preger, *Script. Orig. Const.* 2, 668, 5ff.: ὁ δὲ Ζεῦξιππος τὸ λωετρὸν ὑπὸ Σευήρου κατεσκευάσθη καὶ ἐστοιχειώθη μετὰ κανδήλας ὑέλινος ἄπτεσθαι τὸ δὲ ὕδωρ ζέειν σφοδρῶς, καὶ τὸν ἀέρα τοῦ λουτροῦ.

⁴ *Cath.* 5, 144 (141): *pendent mobilibus lumina funibus, | quae suffixa micant per laquearia, | et de languidulis fota natatibus | lucem perspicuo flamma iacit vitro.*

⁵ *Carm.* 19, 416 (412): *at medio in spatio fixi laquearibus altis | pendebant per aëna cavi retinacula lychni, | qui specie arborea lentis quasi vitea virgis | brachia iactantes summoque cacumine rami | vitreolos gestant tamquam sua poma caliclos.*

⁶ *Id.* 23, 127 (124): *communis in medio tecti cameram inter humumque | nutabat solitus lychnum suspendere funis, | innectens triugum supremo stamine ferrum, | quo vitreae inseritur penetrabilis ansa lucernae | auritusque calix tribus undique figitur uncis.*

⁷ *Vita S. Martin.* 4, 693: *lychnus adest, cuius vitrea natat ignis in urna.*

a *lychnus*, 'lamp,' "whose flame floats in a glass *urna* (vessel.)" In a description of the lighting of Sancta Sophia Paul the Silentiary^{7a} describes a lamp in the center of the church, consisting of a circle of silver discs, "they have been pierced too by the weapon of the skilful workman, in order that they may receive shafts⁸ of fire-wrought glass, and hold light on high for men at night." Bede^{8a} (*S.* 7/8) speaks of the art of glassmaking as being well adapted for the *lampades claustrae* of the church.

2. *Laterna* (lantern). Isidore (*S.* 6/7)^{8b} writes, "A *laterna* (lantern) is so called because it has a light enclosed within it, for it is made of glass with the light inside so that a gust of wind cannot reach it, and for this reason it is easily carried about to furnish light." Eustratius (*S.* 12)⁹ also describes a glass lantern.

I. MISCELLANEOUS

1. *Coffins*. The use of *hyalos* for preserving the dead and for coffins has already been discussed.¹ Although it does not seem probable that any of the examples cited were actually of glass, funeral urns and coffins of glass have actually been found.²

2. *A Glass Rod*. Seneca³ writes, "Glass rods are commonly made, either fluted or bulging with many corners like a club. If one catches the sun transversely, it produces the color which is wont to be seen in the rainbow." These were probably somewhat like the

^{7a} 824 (*Corp. Script. Hist. Byz.* 36 (1837), 39): τοὺς μὲν ἀνὴρ πολὺῶρις ὅλους ἐτόρησε σιδήρῳ, | ὅφρα κεν ἐξ ὑάλου πυρικμήτοιῦ ταθέντας | οὐρίαχους δέξαιντο, καὶ ἐκκρεμές ἀνδράσιν εἴη φέγγεος ἐννυχίοιο δοχήϊον. Translation by Lethaby and Swainson, *op. cit.* 50. See above, n. 3.

⁸ *Loc. cit.* note 1: "οὐρίαχος. Used in Homer of the butt end of a spear; hence long narrow glass lamps."

^{8a} See p. 113, n. 7b.

^{8b} *Orig.* 22, 10, 7: *laterna* inde vocatur quod lucem interius habeat clausam. fit enim ex vitro, recluso intus lumine ut venti flatus adire non possit, et ad praebendum lumen facile ubique circumferatur.

⁹ On *Analyt. Post.* B 11 (Hayduck (1907), 151, 21): ἐξ ἀνάγκης τε γὰρ ἔστιν εἰπεῖν, οἷον διότι μεγαλομερὲς μὲν ὁ ὕελος ἐξ οὗ ὁ φανὸς ἢ εἰ τύχη ἢ δορά, μικρομερὲς δὲ τὸ πόρων τοῦ ὕελου ἢ τῆς δορᾶς ἢ τοῦ πυρὸς λεπτομέρεια.

¹ See above, p. 23ff.

² Dillon, *op. cit.* 55. For a coffin inlaid with glass, see Lefebvre (*Anc. Egypt*, 6 (1921), 85).

³ *Nat. Quaest.* 1, 7, 1: quoniam inquit, vitri fecisti mentionem, ex hoc ipso argumentum contra te sumam virgula solet fieri vitrea, striata vel pluribus angulis in modum clavae torosa: haec si in transversum solem accipit, colorem talem, qualis in arcu videri solet, reddit, ut scias non imaginem hic solis esse sed coloris imitationem ex percussu.

pendent glass prisms that used to be hung about lamps, or in windows for the sun to strike upon them. Of course glass canes are occasionally made nowadays.

3. *Knives.* There is no definite mention of a glass knife, but glass was used for cutting, and the conclusion is that there were glass knives similar to the numerous obsidian ones. To be sure, just a piece of broken glass might be meant, as when Severian broke the largest of his beautiful glass cups and cut his throat with the glass.⁴ However, when Pliny (*S.* 1)⁵ says that balsam should be cut "with a glass, a stone, or bone knives," some regular implement seems to be indicated. On the other hand when Soranus (*S.* 2)⁶ urges that the umbilical cord be cut with a very sharp knife and not according to the superstition of the past with a thread, glass, or the like; or when Apsyrtus (*S.* 4)⁷ recommends that warts should not be burned, but cut and scraped with a glass, it is by no means certain, or indeed even probable, that a special glass-edged knife was in mind.

4. *Ingredient of Paint.* Pliny⁸ describes *anulare* as "the white color with which pictures of women are made light. It is prepared from chalk mixed with glass jewels from the rings (*anuli*) of the common people, and for this reason it was called *anulare*."

In a Greek papyrus crystal is mentioned as an ingredient in a formula for a composition for writing in gold letters.⁹

5. *Improbable or Impossible Uses.* In Lucian's *True History* (*S.* 2) a visit to the moon is described. The people there wore clothing of soft glass,¹⁰ and one of the parting gifts of the king was two glass garments.¹¹ This is doubtless a sheer figment of the

⁴ See above, p. 151, n. 6.

⁵ *N. H.* 12, 115: inciditur vitro, lapide osseisve cultellis. Cf. Solin. 35, 6: lignum candicis attractatum ferro sine mora moritur: ea propter aut vitro aut cultellulis osseis, sed in sola cortice artificii plaga vulneratur.

⁶ 78 (Rose (1882), 28, 23): quando umbilicum praecidere debemus? cum modice infans requieverit in terra, a ventre quattuor digitis longe scalpello aut cultro acutissimo praecidendus est, nec superstitioni antiquorum consentiendum qui lino aut vitro vel canna acuta aut cortice panis secabant.

⁷ Hippiatr. *Vet. Med.* 2, 82, 211: συκή καὶ μυρμηκία· οὐ δὲ καλεῖν ἀλλ' ἀποτέμνειν ξύειν τε ἄσσον (sic) ὕελω.

⁸ See above, p. 148, n. 31.

⁹ Leemans, *Papyri Graeci Musei Antiquarii Publici Lugduni-Batavi* (1885), X, 8, 28ff.: χρυσογραφία. | ἄρσενικὸν χρυσίζοντος Λκ', κρυστάλλου ρει— | νήματος στατήρες δ', ἢ ὡὺ τοῦ λευκοῦ στατήρες β', κόμμεος | λευκοῦ στατήρες κ', κρόκου—, γράψας ξήρενε καὶ ὁ— | δόντιζε.

¹⁰ 1, 25: ἐσθῆς δὲ τοῖς μὲν πλουσίοις ὑαλινὴ μαλθακή.

¹¹ 1, 27: ἐμοὶ δὲ καὶ δῶρα ἔδωκεν ὁ Ἐνδυμίων, δύο μὲν τῶν ὑαλίνων χιτῶνων.

imagination, although a dress of spun glass is said to have been made for Queen Victoria some years ago. Elsewhere large, strong anchors of glass were used.¹² In another connection mention has been made of glass trees whose fruit was drinking cups.¹³

6. *Diving Bell*. Pseudo-Callisthenes (*S.* 3)^{13a} describes something like a diving bell; a glass vessel over seven inches thick within an iron cage. He says that Alexander the Great wishing to attempt the impossible got into this vessel and was able to see the fish about him. It is improbable that this is more than a legend.

7. *Imitation of Foods*. The story is told by Lampridius (*S.* 4)¹⁴ that Heliogabalus tantalized his parasites by Barmecide banquets in which everything was an imitation in glass.

8. *Covering for Surfaces*. The earliest use of glass recorded in literature was for the adornment of surface of walls, chairs, and armor in the form of paste, which was also used so largely in early jewelry. Among the very latest use before the fall of Constantinople was the glass covering for the image of the emperor mentioned by Codinus (*S.* 15), but very different of course in quality and purpose from the former.¹⁵ A colored glass may have been used in covering the staff of the Head Keeper of the Robes at Constantinople, but this is a disputed point.¹⁶

¹² I, 42: καὶ γὰρ ἀγκύραις ἐχρῶντο μεγάλας, ὑαλίναις, καρτεραῖς. Harmon (1913) in note in Loeb Library translation: "Very likely a punning reference to some traveller's account of wooden (ξύλιναις) anchors."

¹³ See above, p. 168, n. 134.

^{13a} *Rel. Script. de Rebus Alex. Magn.* 2, 38, 4ff.: ὑπερόρησεν κλωβὸν σιδηροῦν γενέσθαι μέγαν, ἔσωθεν δὲ τοῦ κλωβοῦ εἰσενεχθῆναι παμμεγέθη ὑέλινον πίθον, ἔχοντα τὸ πάχος σπιθαμὴν μίαν . . . εἰσῆλθεν ὁ Ἀλέξανδρος ἐν τῷ ὑέλῳ πίθῳ μετὰ τοῦ κλωβοῦ βουλόμενος ἐπιχειρεῖν ἀδυνάτοις . . . ἔβλεπεν διὰ τοῦ ὑέλου περικυκλοῦντα αὐτὸν πλήθη ἰχθύων.

¹⁴ *Heliog.* 27, 4: exhibuit parasitis cenas et de vitreis et nonnumquam tot picta mantelia in mensam mittebat, iis edulibus picta quae adponerentur, quot missus esset habiturus, ita ut de acu aut de textili pictura exhiberentur.

¹⁵ See above, p. 52, n. 28-30.

¹⁶ See above, p. 52, n. 25-27.

Addendum. *P. Ox.* IV, 741 (*S.* 2), in a list of household articles, occurs: προχείρια β ἐν οἷς ὑελαῖ (pap. υελα) ἡμισυνθέσεις γ, "2 hold-alls containing 3 half-sets of glass." The word ἡμισύνθεσις occurs only here, but a σύνθεσις was "a service of plate." Note also the adjectival use of ὑέλός.

W. A. O.

VI. HISTORICAL SUMMARY

After a consideration of the evolution of glass from the early pastes to the elaborately carved hollow ware, such as the Portland Vase, or the gorgeously stained windows of Christian churches, the question of its origin still remains unanswered. Although it would give a kind of satisfaction to be able to say that a certain man invented glass at a certain time and place, we can only speculate on its origin. Did some far off potter notice a slight glaze on his vessels as they came from the kiln? Did this chance glaze develop into the beautiful glazes of Egypt and Babylon? By a different combination of ingredients was glass gradually evolved? Or was there an earlier stage as Petrie¹ suggests? He says that "it seems probable that it was invented from finding quartz pebbles fluxed by wood ashes in a hot fire. Hence glazing on quartz was the starting point, and glazing on artificial wares was a later stage." Pliny, the only ancient author who records the origin of glass, gives us no help because he himself does not believe the story of the merchants on the Phoenician shore who supported their cooking utensils with natron, which the heat of the fire fused with the sand of the sea shore, thereby forming glass.

It would be more profitable, however, to turn from fables to what we actually know about glass out of Greek and Latin literature. Ancient glass was chiefly a soda glass,—sand and natron, a natural soda, or ashes being the chief constituents, but other materials, such as lime in the form of shells, and much later lead, were added to give stability and beauty.

In classical times the Greeks did not make glass, and they say very little concerning its manufacture. Strabo in his travels tells more about glass, although incidentally, than any other Greek author. The Romans developed the art extensively, but they had no Greek source to fall back on, and with the exception of Pliny's detailed, although somewhat confused account, the Roman authors seldom mention the making but rather the uses or characteristics of glass. We do hear of glass factories, which in some instances were used as lounging places by the poor, and from inscriptions on glass objects we know that there were factories employing a number of

¹ *The Arts and Crafts of Ancient Egypt* (1909), 107.

workmen. The furnace ovens were heated with some light dry wood, as tamarisk, or papyrus, which could be removed when it was desirable for the ovens to cool down. After the ingredients were mixed in proper proportions, they were gradually heated until they fused; then they were reheated, at least in Pliny's time, until a pure transparent glass resulted. Many stones and colors were imitated in glass, but few of the formulae for coloring have been preserved. There was a certain mystery in this change from sand to clear or colored glass, which appealed to alchemists.

The constituency of the molten glass and the method of working it depended both upon the particular period in its development and upon the taste of the workman. For many centuries glass was an opaque paste used chiefly for jewels, or the adornment of surfaces, such as walls. It is uncertain just when transparent glass was developed. When the word *hyalos* came into use in Greece, at least by the fifth century before Christ, its chief characteristic was transparency; yet this quality must have been greatly improved, for in the first century of our era glass like crystal was highly prized, indicating that it was still rare and difficult to make. Colored glass whether opaque or transparent was extremely useful in imitating gems, in producing a colorful variety in utensils, and later in colored glass mosaics and church windows.

Until sometime in the Ptolomaic or Roman period all hollow ware was made by hand, usually about a core of sand. It is evident that the output would be comparatively small and costly. But with the invention of the blow-pipe glass-making became of real importance, and performed a great practical and artistic service. The relative extent of its employment in antiquity is not surpassed today. Aside from its usual forms it was blown into odd and grotesque shapes. Glass was also worked upon the lathe and carved. We read of "Homeric cups," probably of glass, so called from the scenes portrayed upon them. The finest examples of carving are those in which a white glass is fused to a dark glass vessel and then carved away like a cameo, as in the Portland vase with its dark blue background, and the Naples amphora with white on brown. There was not only carving in relief and intaglio, but also a very complicated net-work carving. Differently colored threads of glass were used from early times for surface decoration. In the Christian era designs of gold leaf were fused between two transparent pieces of

glass. At a later time slabs of glass were made by a cylinder process and painted for church windows. There was such an effort to use glass in every possible way and such a desire to preserve the costly pieces, which were handed down from one generation to another, that we have the development of the popular story of the manufacture of malleable glass. Although glass was common, certain difficulties seem to have been present in its manufacture. There were formulae for mending broken vessels and indications that they were sometimes remelted to save preliminary fusing.

On many of the glass vessels one finds the signature of the maker or the factory. A number of these workmen sign their names as Sidonians, but most of them probably came to Rome to work. In many instances the ancient workman was no doubt migratory, as in America in early days, seeking better conditions under which to work, a greater demand for his work, and taking his patterns with him. We hear of a Carthaginian glass-maker in Gaul, an incident which helps to confirm this view. During the brightest days of Venice her glass-workers, although showered with privileges, were kept as virtual prisoners upon the island of Murano so that the secrets of their methods would not be disclosed. Literature and sepulchral inscriptions also add to the list of glass workers. From various sources we hear of Egyptian, Sidonian, Roman, Carthaginian, Gallic, Greek, and Jewish glass-makers. The work demanded both skill and labor. There was the danger of being burned by the molten glass, of inhaling while the blow-pipe was at the mouth, and of being blinded by the fire. On the other hand the glass workers, as a group, prospered and received many considerations. Some of them like Frontinus owned large factories where poorer workmen, freedmen, and possibly slaves were employed, but most of the workmen at first probably had small furnaces which they worked alone or with little help. These factories have given their name to streets, gates, and ports near which they were located. In Byzantine times protective measures directed against fire and disease forced the factory owners to move outside the city or into sparsely populated districts. The Roman workmen of the third century must have been considered prosperous when they were taxed by Alexander Severus. On the other hand local glass products were protected and foreign luxuries taxed by Aurelian. But the greatest appreciation of the work of the glass-maker was shown by Constantine when he freed

the workers from personal taxation so that they might perfect their art and train their sons in it.

It is impossible to determine the earliest centers of manufacture from literature alone. As stated above the choice of a factory site depended largely on natural supplies of sand, natron, and wood for fuel and ashes. The sand deposits most frequently mentioned were those of Phoenicia, Egypt, Italy, Gaul, and Spain. The earliest and most frequent references to foreign glass in Greek and Latin literature are to Egyptian glass, but the most detailed accounts of manufacture are given of Sidonian and Roman glass. The making of glass in Asia was not confined to Sidon, although it was not until later times that we hear of its manufacture in Tyre, Antioch, and Constantinople. The Jews seem to have gained control of its manufacture in the East before the tenth century at least. From the East, no doubt, the art spread to the daughter city of Carthage and its neighborhood. There is slight indication of the manufacture of glass in Greece in classical times, but Theophilus speaks with familiarity of Greek glass, meaning thereby, of course, Byzantine. Glass was made in Rome and Puteoli to judge from the names of streets taking their names from the trade. In Gaul too there are localities bearing names which indicate that factories once flourished in them. Many local, signed vessels occur in Gaul, and the Gauls even exported trifles to Briton before the Christian era.

Not only the numerous glass vessels which have withstood the vicissitudes of time bear witness to the importance of the trade but also the numerous references to glass in Greek and Latin literature. The importance of glass is shown in literature in two ways: in the first place, the various words for glass, and their derivatives are used in describing and comparing things of the greatest diversity, and in the second place, many of the numerous forms and uses of glass are mentioned. The first Greek word for glass *kyanos*, named from its dark-gleaming appearance, was applied to blue glass paste in Homer. Next came the old picture word "molten stone," and finally *hyalos* (*hyelos*, *hyellos*), whose derivation and spelling were frequently discussed by ancient grammarians and etymologists. *Hyalos* seems to have been applied to any transparent substance, as crystal, glazes, precious stones, and amber, but especially to glass. The characteristics of it and its derivatives and compounds which were most commonly alluded to were transparency, brightness,

glistening appearance, solidity, brittleness, smoothness, hardness, consistency in the molten state, and possibly greenness. Some form of *hyalos* was used in the description of the sun, moon, a humor of the eye, the humors and phlegms of the body, the cheek, eye, eye disease, a membrane, resin, gums, slag of lead, gems, sand, asphalt, a breast-band, air, a sea, a pear, and moral qualities. In the substantive form it stands for cups, mirrors, windows, and humors. Sometimes *krystallos* stands for crystal glass, and *morria* indicates an opaque colored glass—the Millefiori. The Latin transliterated form *hyalus* and its derivatives, aside from the meaning ‘of glass,’ indicated something green and shining. *Vitrum*, of unknown origin like *hyalos*, does not occur until the first century before Christ, and aside from the herb, which is designated by the same word, *vitrum* is applied to glass with the exception of one reference to ice. The characteristics of glass which appealed to the Roman writers were very much the same as those which the Greeks mentioned: a bright and shining appearance, transparency, fragility, sharpness when broken, and its appearance and consistency when molten. To these characteristics the adjectival forms add clearness, greenness, a sparkling appearance, inconstancy, fickleness of heart, and changeableness of mind. The Latin comparisons with glass have to do with a toga, gems, water in every amount, waves on tapestry, nymphs, their abodes, looms and wool, wine, ice, frost, reflection of surfaces, a sea urchin, bile, humor of the eye, humors of the body, the human body, fruits, herbage, Circe, fame, fortune, wealth, pleasures, opinions, and moral qualities. In the substantive form it stands for a glass vessel, gems, and a window, and ‘broken glass’ indicates mere trumpery.

As for the material itself or objects made of it, at first we find them classed with precious stones and metals, prized by the nobility and the wealthy, and, indeed, at all times, as even yet, there have been some rare pieces which were so considered, while on the other hand by the first century ordinary glass had become very cheap and was employed for the most practical and trivial uses. Among the first uses mentioned in literature was the adornment of surfaces, such as walls, armor, and a table. The use of glass paste on walls was later supplanted by slabs of glass and mosaics. It was also used on floors and columns. But probably the most early common use was in imitation of stones, as the emerald, lapis lazuli, crystal, *murra*, opal, *carbunculus*, topaz, jasper, *hyacinthus*, obsidian, sapphire, pearls,

onyx, and many others, for the adornment of objects, for earrings, rings, baubles, cups, amulets, and other articles. With the invention of the blow-pipe hollow ware came into general use. Although the most common form was the drinking vessel, there was also in use almost every type of vessel for food and drink, goblets, cups, stands for cups, bowls, ladles, table services, household utensils, platters, pots, jars, bottles, flasks, amphoras, urns, globes, boxes, mortars, cupping glasses, vessels in the form of a pierced nipple, and cups of obscene form. Some of these vessels had special names as the *petroti*, four nozzled Vatinian cups, Homeric cups, *diatrete*, *toreumata*, *alassontes*, and Thericlean cups. Since the ancients did not have China-ware, glass vied with the metals to fill a place which is now largely usurped by porcelain. A 'glass' stood for a glass cup in antiquity as well as today. The more elaborate pieces were prized above the metals or despised according to the taste of the individual. Complete table services of glass were sometimes used; at other times we read of goblets for wine, cups for water, platters for fish, and once of a banquet where all foods were glass imitations. Just as today, glass was used for wine bottles, flasks, and jars, oil containers, water coolers, jars for ripening citrons, and preserving fruits, mulberries, apples, grapes, figs, pickles, alissander, and skirret roots. Among toilet articles were the glass perfume bottle and the container for unguents. Glass also served as an excellent receptacle for medicines and their ingredients, such as balsam, and eye salve, but it was still more useful to the physician as a kind of test tube for examining fluids. It was also employed as a cupping glass, and urinal. In pagan worship we read of a glass incense bowl, and in Christian services of a glass chalice. The transparency of glass was made use of in Archimedes' sphere, in a globe of water used for a burning glass, and mentioned as having the power to magnify ordinary objects, in a special vessel in which the changing colors of a dying mullet could be watched, in a vessel of water for the performance of mantic rites, and in a vessel for holding a lizard in connection with a superstitious remedy for eye troubles. As already indicated the physician made great use of glass utensils for holding medicines and examining fluids, as well as burning glasses in the form of a lens or globe of water for cauterizing wounds. But by far the most unusual use for glass was as an ingredient in certain medicines and plasters. Colored glass was used to shade and rest the eyes. Among

Roman playthings glass pawns and balls are mentioned. Pieces of dark glass and later, at least by the third century, small metal-backed mirrors had a limited use. From excavations in Pompeii we know that small glass windows were not unknown, but by the fourth century they had not usurped the place of other transparent materials. The great development of windows came in the adornment of the Christian churches. Glass church lamps were mentioned in the fourth century. About three centuries later glass lanterns make their appearance. A few other uses are recorded, as for rods, knives, darts, and as an ingredient in paint. The stories of glass coffins and burial in glass are very improbable. Likewise the description of glass garments, anchors, trees, and diving bells are, no doubt, mere figments of the imagination.

From this brief summary we can see that Greek and Roman writers tell of the actual objects of glass, or, use these objects, or more often simply the material itself, as a standard of comparison, to a far greater extent than they dwell on the methods of manufacture. The limited accounts of materials, methods, and kinds of glass are, however, partially supplemented by some medieval works, which must have drawn most of their information from antiquity. About the tenth century Heraclius, who probably lived in Rome, wrote two books of didactic poetry, *De Coloribus et Artibus Romanorum*, in which many facts especially on glassmaking are crudely set forth. Two or three centuries later there appears a third book in prose on the same topic and ascribed to Heraclius. This book contains a number of chapters on glass-making, its origin and history, the subject matter of which comes from the two didactic books of Heraclius, from Pliny, and Isidore. Sometime in the period between the two poetic books of Heraclius and the third book in prose of pseudo-Heraclius, appears the *Diversarum Artium Schedula* by Theophilus, "the servant of the servants of God," as he calls himself (*Pref.* Bk. I). Much earlier than either these is the anonymous tractate *De Musivis*, preserved in an eighth century MS at Lucca, which contains a number of receipts for glass along with other chemical lore.¹

¹ Those who may be interested in these curious documents are referred to a new critical text of these treatises together with a few pertinent extracts from Byzantine and other alchemical MSS. and papyri (accompanied with a translation), which is being prepared by Dr. W. A. Oldfather.

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¹ This bibliography does not include the editions of the Greek and Latin authors, lexica, etymologica, and collections of inscriptions and papyri, for these are in each case the well known standard works. Modern writers upon the general history and philology of ancient glass are not numerous. The following are the principal works which have been used in the preparation of this thesis. The titles of publications which only incidentally touch upon aspects of the present study are given fully wherever cited in footnotes, and need not be repeated here.

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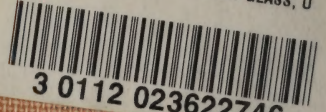
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Mary Luella Trowbridge was born near Green Valley, Illinois, February 4, 1894. In 1911 she graduated from Delavan High School; during the year 1911-1912 she attended Bradley Polytechnic Institute; from 1912-1916 she studied at the University of Illinois. In 1915 she was elected to Phi Beta Kappa and received the A.B. degree; the following year she was a Scholar in Classics and received the A.M. degree. In the second semester of the year 1916-1917 she went to Wasatch Academy, Mt. Pleasant, Utah, where she taught Latin and German for two years and was also assistant principal for the last year. During the summer of 1917 she did graduate work at the University of Wisconsin and during the summer of 1918 at the University of California. In the second term of the year 1918-1919 she returned to the University of Illinois, where she held a Fellowship in Classics in 1919-1920. During 1920-1921 she studied at the School of Classical Studies of the American Academy in Rome, and in September of the year 1921 she returned to the University of Illinois as a Fellow in Classics.

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